DETROIT PUBLIC LIBRARY

Regd. No. BG. 263

SUPPLEMENT: AUTHOR AND SUBJECT INDEX

MAR 9 1962

GENERAL INFORMATION

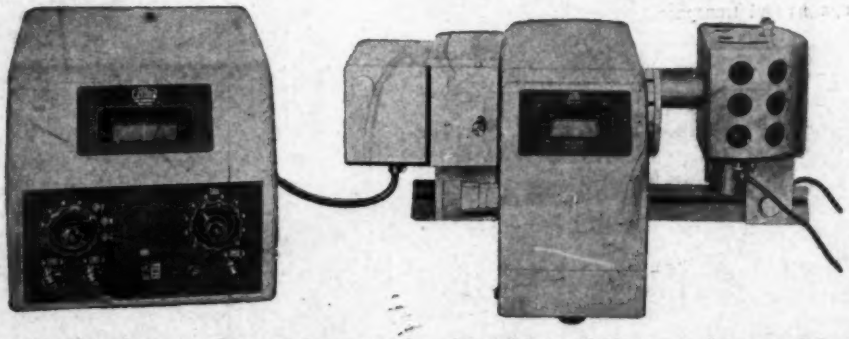
Current Science

Vol. 30, No. 12 DECEMBER 1961 Pages 447-487

CARL ZEISS

SPECTROPHOTOMETER

Mains-operated Model PMQ II



Wavelength range from 185 mμ in the ultraviolet to 1100 mμ in the near infrared region with high spectral resolution. With special equipment, the upper limit is extended to 2500 mμ whereby numerous absorption bands of organic materials are detectable in the near infrared region. Supplementary equipments for chromatography, fluorescence measurement, etc.

Sole Agents;

ADAIR, DUTT & CO. (India) Private LTD.

CALCUTTA MADRAS SECUNDERABAD BOMBAY NEW DELHI

STEREOZOOM

MICROSCOPES

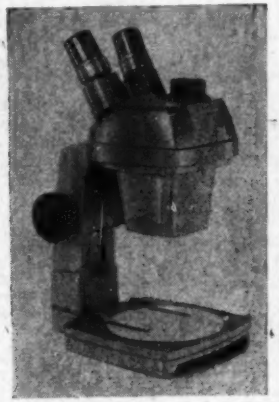
Illustrated below are some of the models available for different types of work

Series BVB
for opaque and transparent objects

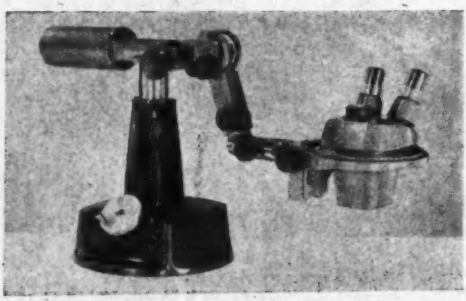
BAUSCH & LOMB

Made by

BAUSCH & LOMB INC.
ROCHESTER, U.S.A.



Series AVB
for opaque objects

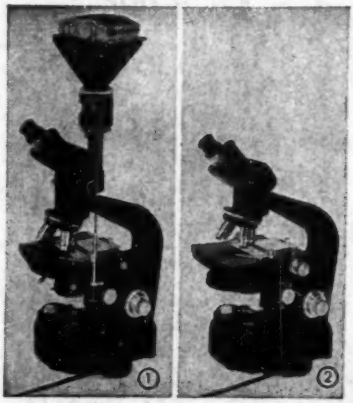


Series SKVB
for opaque objects in any plane

Series ADM
for depth measuring

SOLE AGENTS

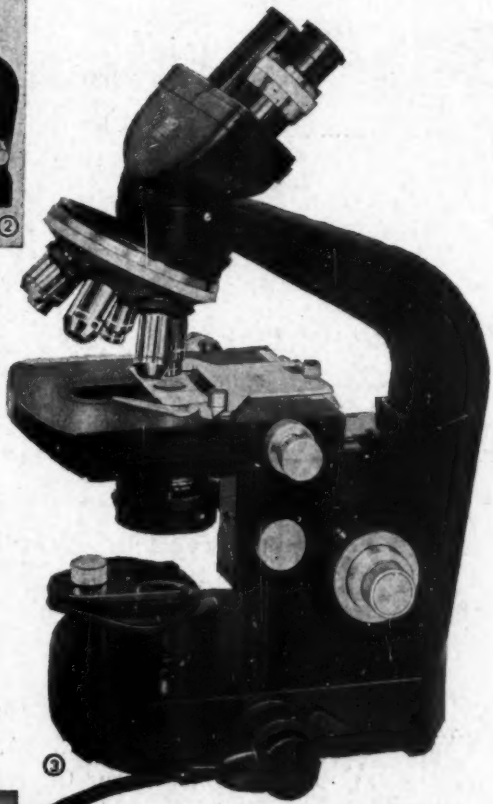
MARTIN & HARRIS PRIVATE LTD.
(SCIENTIFIC DEPT.) SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1



WILD
HEERBRUGG

* The most COMPLETE Microscope so far made

* Ideal for QUALITY PRECISION & VARIETY



WILD M 20

The M 20 Microscope with few of its attachments.

Fig. 1 : With Micro Camera and Binocular Tube;
Fig. 2 : Equipped as Phase Contrast Microscope;
Fig. 3 : With Six-Hole Nosepiece; Filter Exchanger, etc.;
Fig. 4 : Built-in Illuminator for Kohler Illumination.

Sole Agents:

RAJ-DER-KAR & CO.

Sadhana Rayon House
Dr. D. Naoroji Road
BOMBAY-1

Telephone: 26-2304 Telegram: TECHLAB

Branch Office:
44/6 REGAL BUILDING
CONNAUGHT PLACE
NEW DELHI-1

Gansons

- **GAS PLANTS** Electrically operated
- **GAS PLANTS** Weight Driven
  For Field Laboratories and places without electricity
- **LABORATORY EQUIPMENT AND APPLIANCES**
  Incubators, Ovens, Baths, Shakers, Stills
- **RADIOACTIVE ISOTOPES**
  Equipment for handling and storing
- **STAINLESS STEEL FABRICATION**
  Pilot Plants, Tanks, Kettles, Pressure Vessels for Pharmaceutical, Chemical and Food Processing Industries
- **ORE DRESSING PLANTS & EQUIPMENT**
  Wilfley Tables, Froth Flotation Cells, etc.

GANSONS PRIVATE LIMITED

P.O. BOX 5576 BOMBAY-14

FROM READY STOCK

THERMOCOUPLES & PYROMETERS

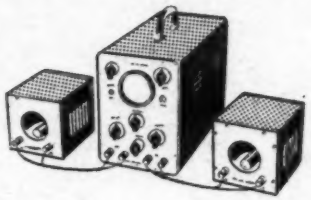
* INDICATORS (VARIOUS TYPES) for temperatures from 600° to 1600° C.
* THERMOCOUPLES (VARIOUS TYPES) Iron/Constantan, Chromel/Alumel and Platinum/Pt. Rhodium.

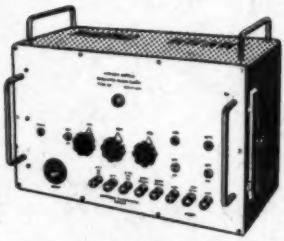
For further details concerning HEAT TREATMENT please contact:

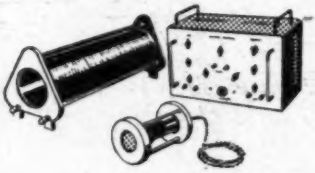
LABORATORY FURNISHERS

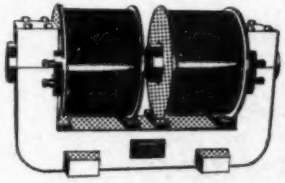
DHUN MANSION, 186 C. VINCENT ROAD
DADAR, BOMBAY 14
Branch: **AHMEDABAD**

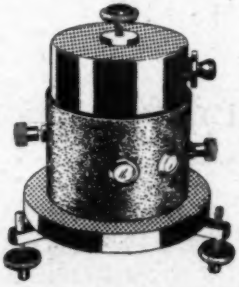
GRAMS: 'LABFURNISH', BOMBAY, DDR PHONE: 62761











The Instruments we make...

ELECTRONIC TEST INSTRUMENTS
Oscilloscopes
Audio Oscillators
Pulse Generators
Vaccum Tube Voltmeter
Null Detector
Absorption Frequency Meters
Transistor Tester
Transistorized A.F. Oscillator
Transistorized Null Detector

REGULATED POWER SUPPLIES
Variable Voltage Regulated Supplies 0–300 v, 0–400 v, 0–500 v
High Voltage Supplies
Transistorized L. T. Supplies

INDUSTRIAL TEST INSTRUMENTS
Magnetic Tester
Insulation Tester
Tesla Coil for Vaccum Testing

INDUSTRIAL CONTROL EQUIPMENT
Process Timers
Batch Counters
Temperature Controller

ELECTROMAGNETS AND ACCESSORIES
Electromagnets 2", 3", 4"
D. C. Supplies and Current Regulators
Search Coils

PHYSICS APPARATUS
Oil-drop Apparatus
"e/m" Apparatus
Motor Rotator

DEMONSTRATION APPARATUS
Short Wave Apparatus
Photo-electric Relay
Radioactivity Demonstrator
Tesla Coil

UNIVERSAL SCIENTIFIC CO.

32, PAREKH ST., BOMBAY 4

PHOTOVOLT pH METER

MODEL 85

A FULLY STABILIZED AC LINE-OPERATED METER
FOR 200-250 V. 50-60 CYCLES

Manufactured by:

PHOTOVOLT CORPORATION, U.S.A.

SIMPLE IN OPERATION : DEPENDABLE IN SERVICE

3" Scale Length, pH 0 to 14

Scale Divisions: 0·2 pH. Readable to 0·1 pH.

Please Write for Details to:

GORDHANDAS DESAI PRIVATE LTD.

SIR PHEROZESHAH MEHTA ROAD, BOMBAY 1

Branches:

P-7, Mission Row Extension
CALCUTTA 1

4/2B, Asaf Ali Road
NEW DELHI

22, Linghi Chetty Street
MADRAS 1

only the best filter papers

You cannot be too careful about the filter papers you use. For consistently accurate results use only GENUINE WHATMAN papers in your laboratory. They are made by modern techniques that guarantee their quality: their properties are examined and controlled at every stage of manufacture. They are preferred by leading scientists throughout the world because with Whatman you can be sure you are getting the correct results in all filtration procedures. They have no substitute. So look at the label carefully and see that it is GENUINE WHATMAN before you buy.

ensure correct *results*

BE SURE

H. REEVE ANGEL & CO. LTD
Gt. Britain: 9 Bridewell Place, London EC4
USA: 9 Bridewell Place, Clifton, New Jersey

Sole distributors of

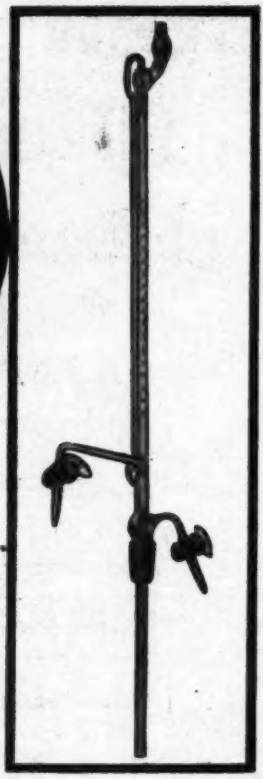
WHATMAN FILTER PAPERS

Manufacturers W & R Balston Ltd

this is English

PYREX

Regd. Trade Mark



It is chosen because

'PYREX' BOROSILICATE GLASS

- withstands thermal shock—its coefficient of expansion is extremely low
- resists chemical attack
- has exceptional mechanical strength—considerably reducing replacement costs
- can easily be cleaned and sterilized

and is constant in all its standards of accuracy and all its characteristics

ENGLISH 'PYREX'
scientific and laboratory glassware

Made in England by James A. Jobling & Co. Ltd., Wear Glass Works, Sunderland.

Available from all leading distributors

Sole Agents: **GORDHANDAS DESAI (PRIVATE) LTD.**

SIR PHEROZESHAH MEHTA ROAD, FORT, BOMBAY 1

Also at: **CALCUTTA MADRAS NEW DELHI**

VACANCY FOR AGRICULTURAL ADVISORY OFFICER

A Vacancy exists for an Agricultural Advisory Officer on the Scientific staff of the Indian Tea Association in the tea districts of N.E. India.

Candidates must have a good honours degree in Agriculture, or Pure Science, and preference will be given to a candidate with suitable post-graduate training, or experience in agriculture.

Salary *plus* allowances will be paid in the scale Rs. 1,270–2,870 p.m. (slightly less for unmarried applicants), commensurate with qualifications and experience, together with other amenities, Provident Fund, etc. Applications should be submitted to **The Secretary, Indian Tea Association, P.O. Box 2261, Calcutta-1,** together with full statements in duplicate of qualifications and experience; original references and copies of publications, if any.

We design and supply :

VARIOUS TYPES OF

ELECTRONIC EQUIPMENT

SUCH AS

STABILIZED POWER SUPPLY UNITS

BATTERY CHARGERS FOR HOME, GARAGE AND GENERAL PURPOSE
NEON SIGN TRANSFORMERS

CONSTANT VOLTAGE, BOOSTING, GLOW DISCHARGE, STEP-UP, STEP-DOWN TRANSFORMERS

BATTERY ELIMINATORS, METAL RECTIFIERS, WAVE-BAND SWITCHES, ETC., ETC.

FOR ANY DESIRED SPECIFICATIONS

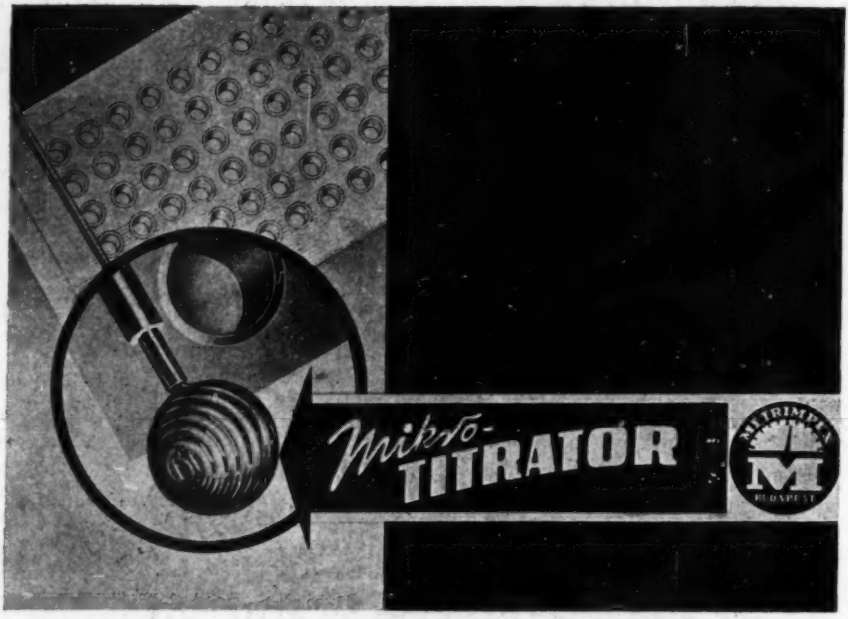
We have been designing and supplying to the market various Electrical and Electronic Equipment for over 15 years past

GUARANTEED SERVICE PROMPT ATTENTION

RADIO ELECTRIC (PRIVATE) LTD.

2 B, LAMINGTON CHAMBERS, LAMINGTON ROAD

BOMBAY 4



The **MICROTITRATOR** spiral-loop dilution technique simplifies and accelerates the serologic titration process and furnishes reliable test results at a minimum expenditure of reagent. After a little practice it will be found easy to handle up to six loops at a time, each with a different material to be diluted. A particular advantage of the method over titrations using pipettes is that about one-tenth of the quantity of reagent will suffice.

METRIMPEX

Hungarian Trading Company for Instruments
BUDAPEST, HUNGARY

Sole Representatives:

ARMSTRONG SMITH LIMITED

Regd. Office :

GRESHAM ASSURANCE HOUSE
1 SIR P. MEHTA ROAD. POST BOX 185
BOMBAY 1

POST BOX 787	POST BOX 1618	POST BOX 670
CALCUTTA	**MADRAS**	**NEW DELHI**

ZEISS Optical Strain Tester 300

For qualitative optical strain investigations in linear and circular polarized light. Equally well suited for demonstrations.

in **Didactics**

at professional institutes and colleges

in **Research**

and

in **Routine Work** in

Building and Engineering and Other Provinces

CARL ZEISS JENA

VEB CARL ZEISS JENA

(German Democratic Republic)

Sole Agents:

GORDHANDAS DESAI PRIVATE LIMITED

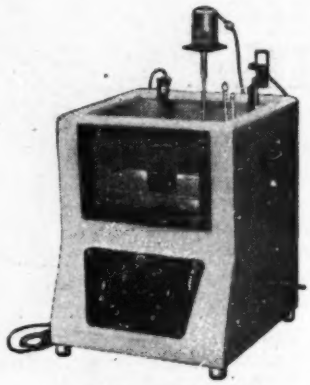
PHEROZESHAH MEHTA ROAD, BOMBAY-1

Branches:

P/7, Mission Row Extension
CALCUTTA 1

4/2 B, Asaf Ali Road
NEW DELHI 1

22, Linghi Chetty St.
MADRAS 1



HIGH PRECISION
THERMOSTATIC BATH
(Sensitivity ± 0·01°C.)

ALSO

• COLD INCUBATORS
(Below or Above Freezing Point)
• AUTOCLAVES • DRYING OVENS
• INDUSTRIAL DRYING CHAMBERS
• WARBURG'S APPARATUS
• THERMOSTATS • LOW TEMPERATURE BATHS • WATER DISTILLATION STILLS

and

Other Scientific Instruments

Manufactured by:

UDAY SCIENTIFIC INDUSTRIES PRIVATE LTD.

5, BHABANATH SEN STREET, CALCUTTA-4

GRAM : 'UDAYINDUST' PHONE : 55-3777

INSIST ON

"QUICO"

PRODUCTS

"QUICO"

BATH SEROLOGICALS
FIXED TEMPERATURE

Double walled inside of which is made of hard rolled copper sheet or brass N.P. and outer M.S. sheet painted grey silver hammertone, with khan racks & thermometer holder but without thermometer. These baths will be supplied to work at constant temperature of either 37° C. or 56°C. as desired. Supplied complete with cord and plug, indicating lamp, etc., to work on 220 volts AC/DC universal mains.

(Bath Serological-variable temperature and baths made from stainless steel will be quoted on specific enquiry.)

Please Contact Sole Selling Agents:

UNIQUE TRADING CORPORATION

221, Sheriff Devji Street, BOMBAY-3

Phone : 30011 **Gram : "UNILAB"**

INSIST ON

BDH

LABORATORY CHEMICALS AND REAGENTS

Their exceptional reliability and high standards of quality are recognised throughout the world.

LABORATORY REAGENTS ★ ★ 'ANALAR' REAGENTS

INDICATORS ★ ★ BIOCHEMICALS

MICRO-ANALYTICAL REAGENTS ★ ★ REAGENTS FOR CLINICAL ANALYSIS

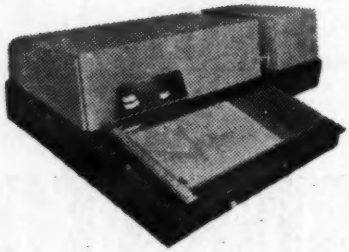
MICROSCOPICAL STAINS AND STAINING SOLUTIONS ★ ★ TEST PAPERS AND TESTING OUTFITS

BRITISH DRUG HOUSES (INDIA) PRIVATE LTD.
LABORATORY CHEMICALS DIVISION,
8 Graham Road, Bombay-1

MOST MODERN SPECTROPHOTOMETERS

Ex: M/s. BECKMAN INSTRUMENTS INC., U.S.A.

IR4 INFRA-RED SPECTROPHOTOMETER



Special Features:

* Double Beam-Optical Null—for high resolution scans.
* Double Monochromator—for high resolution and low stray light with all optics.
* Single Beam Linear Amplifier—for high quantitative accuracy.
* Simplicity—for easy operation by any technician.
* Flexibility—for most variable studies.
* Sound Design.
* Optics NaCl, LL.F, CaF2, KBR, Cs. Br.

OTHER BECKMAN SPECTROPHOTOMETERS:

DU Spectrophotometer, B Spectrophotometer, DK Recording UV-Near Infra-Red Spectrophotometers, DB Recording Spectrophotometer, etc.

'SERVICE AFTER SALES A SPECIALITY'

Sole Agents:

TOSHNIWAL BROS. PRIVATE LTD.

198, JAMSHEDJI TATA ROAD, FORT, BOMBAY 1

BRANCHES:

'RIVAL', KACHERI ROAD AJMER (RAJASTHAN) | 11, BRITISH INDIAN ST. CALCUTTA 1 | 14-B/4, N.E.A. UTTARI MARG NEW DELHI 5 | ROUND TANA, MOUNT ROAD P.O. MADRAS 2

Current Science

Vol. XXX] DECEMBER 1961 [No. 12

CONTENTS

PAGE

Principles of Nuclear Magnetism 447

Coumarin as the Stimulator of Growth of Etiolated Maize Stem Tissue—J. S. KNYPL AND A. P. DMITRUK 448

Nuclei for Rain Formation 449

Studies in the Enzyme Make-up of Alternaria. *I. Qualitative Demonstration of Enzymes*—S. N. DAS-GUPTA AND J. P. VERMA 450

Letters to the Editor

Dissymmetry Measurements of High Polymer Solutions at High Dilutions—V. V. VARADAIAH AND V. S. R. RAO .. 453

Ultrasonic Velocity in Some Inorganic Solutions and Melts—S. V. SUBRAHMANYAM 454

Diamagnetic Susceptibilities of Some Isomeric Monosubstituted Nitrobenzenes —Effect of the Position of the Substituent Group on Susceptibility and the Susceptibility Contribution of the Nitro-Group—S. M. SHAH, R. N. MERCHANT AND M. G. DATAR 455

Magnetism and Molecular Structure: The Estimate of Metal-Nitrogen Bond in Cadmium Chloride Complexes of Organic Bases—V. G. SONALKAR AND M. G. DATAR 456

Gravimetric Determination of Cerium (IV) and its Separation from Rare-Earth Using 1-Hydroxy Xanthone—BRAHM DEV AND B. D. JAIN 457

A Compact Calomel Reference Electrode Particularly Useful in Applied Electrochemical Investigations—S. R. RAJAGOPALAN AND B. V. K. S. R. A. TILAK. 459

Sulphonamidoiodophthaleins—C. R. MEHTA, J. R. KALKE AND N. B. SHAH .. 460

Distribution of Nicotinamide Deamidase in Germinating Pulses—M. A. MUKUNDAN, T. K. SUNDARAM AND E. R. B. SHANMUGASUNDARAM 461

Amino-Acid Deficiency of the Proteins of Lucerne Leaf—B. K. SUR AND P. P. SINGH 462

One-Way Cross-Resistance of Streptomycin and Kanamycin—P. M. NAHA .. 462

Dermatoglyphic Study of Tribes and Castes of Nilgiri Hills (Madras State)—M. R. CHAKRAVARTTI AND D. P. MUKHERJEE .. 463

The Marine Wood-Borer, Xylophaga *from Bay of Bengal*—P. N. GANAPATI AND M. V. LAKSHMANA RAO 464

A Note on the Feeding Mechanism of X. cheopis—P. J. DEORAS AND A. K. JOSHEE 465

Viability of Stored Seed Wheat Safeguarded by Seed Dressing—A. C. SEN 466

A Localised Chlorophyll Deficiency Associated with Male Sterility in Nicotiana tabacum *L.*—G. S. MURTY, K. V. KRISHNAMURTY AND B. R. MURTY 467

On the Morphology of the Pollen Grains of the Two Species of Cucurbita *L.*—MISS PRITI AWASTHI 469

A New Species of Alternaria *from Bombay-Maharashtra—II*—VASANT GURUNATH RAO 470

Structure and Ontogeny of Epidermal Appendages on the Floral Organs of Ocimum basilicum *L.*—SNEH LATA MATHUR 471

Response of Hybrid Maize to Zinc Fertilization—L. R. AHUJA AND O. P. GAUTAM 473

A Note on Vegetative Propagation of Cultivated Rice—N. R. NAIR AND P. C. SAHADEVAN 474

Inheritance of the Retule (Notched) Leaf Apex in a Cross between Crotalaria striata *DC. and* C. mucronata *Desv.*—S. R. CHANDRASEKHARIAH AND N. S. PARAMESWAR 476

Nucleolar Number and Polyploidy Level —S. L. TANDON AND B. M. KAPOOR .. 476

Preliminary Studies on Presoaking of Cereals in Antibiotics—M. P. BHATNAGAR, UDAI BHAN SINGH, G. S. SHEKHAWAT AND B. N. MATHUR .. 477

Reviews 479

Science Notes and News 485

ANNUAL REVIEW OF

MICROBIOLOGY

Vol. 15 **October 1961**

Editors: **C. E. CLIFTON, S. RAFFEL, M. P. STARR**

Contents:

Physiology of Actinomycetes, *V. W. Cochrane*

Continuous Culture of Microorganisms, *T. W. James*

Fine Structure of Protozoa, *H. W. Beams and E. Anderson*

Interactions Between Pesticides and Soil Microorganisms, *W. B. Bollen*

The Family Brucellaceae in Veterinary Research, *E. L. Biberstein and H. S. Cameron*

Metabolism of C_1 Compounds in Autotrophic and Heterotrophic Microorganisms, *J. R. Quayle*

Phage-Host Relationships in some Genera of Medical Significance, *N. B. Groman*

Plant-Nematode Inter relationships, *J. W. Seinhorst*

Sugar Transport in Microorganisms, *V. P. Cirillo*

Structure of Viruses, *J. S. Colter and K. A. O. Ellem*

Gaseous Sterilization, *C. W. Bruch*

Antigenic Variation in Unicellular Organisms, *G. H. Beale and J. F. Wilkinson*

Recent Experience with Antiviral Vaccines, *V. M. Zhdanov*

349 pages

NUCLEAR SCIENCE

Vol. 11 **December 1961**

Editors: **E. SEGRÈ, G. FRIEDLANDER, W. E. MEYERHOF**

Contents:

Statistical Methods in High-Energy Physics, *Martin Kretzschmar*

Strong Interactions and Reactions of Hyperons and Heavy Mesons, *G. Morpurgo*

Theories of Nucleon-Nucleon Elastic Scattering, *Michael J. Moravcsik and H. Pierre Noyes*

Nuclear Orientation, *Louis D. Roberts and J. W. T. Dabbs*

Shielding of High-Energy Accelerators, *S. J. Lindenbaum*

Neutron Capture Gamma Rays, *G. A. Bartholomew*

Neutron Diffraction, *M. K. Wilkinson, E. O. Wollan and W. C. Koehler*

Nuclear Effects of Cosmic Rays in Meteorites, *James R. Arnold*

Detection of Nuclear Explosions, *R. Latter, R. F. Herbst and K. M. Watson*

Heavy-Ion Accelerators, *Edward L. Hubbard*

Isotope Effects in Chemical Reactions, *Ralph E. Weston, Jr.*

Industrial Uses of Isotopes, *W. F. Libby*

513 pages

each $ 7.50 postpaid

Annual Reviews, Inc., 231 Grant Ave., Palo Alto, Calif., U.S.A.

PRINCIPLES OF NUCLEAR MAGNETISM*

SINCE the first successful detection of nuclear resonance signals in 1946, independently by Bloch *et al.* and Purcell *et al.*, Nuclear Magnetic Resonance or NMR spectroscopy has become an important tool of research in diverse fields, such as chemistry, metallurgy, geology and biology. The rate at which the application of this technique is developing is phenomenal. Besides its first and obvious application to the measurement of nuclear moments, currently it is the most successful method of obtaining precise information on the finer properties of matter in bulk. Structure of molecules, reaction rates and chemical equilibria, chemical bonding, crystal structures, internal motions in solids and liquids, electronic densities in metals, alloys and semiconductors, internal fields in ferromagnetic and antiferromagnetic substances, density of states in superconductors, properties of quantum liquids, are some of the topics where nuclear magnetic resonance experiments have so far provided specific and detailed information. This wealth of applications should not, however, obscure the fact that nuclear magnetism is in its own right one of the most fascinating domains of pure physics.

Following the original suggestion made by Pauli in 1924 to explain the hyperfine structure of spectral lines, it has been now well established that atomic nuclei possess in their ground state a non-zero spin angular momentum $Ih/2\pi$ (where I is an integer or half integer), and, collinear with it, a dipolar magnetic moment $\mu = \gamma Ih/2\pi$, where γ is the gyromagnetic ratio which is characteristic of the nucleus. The order of magnitude of these magnetic moments is between 10^{-3} and 10^{-4} Bohr magnetons. It is these moments that give rise to 'nuclear magnetism'.

Besides the difference in the order of magnitude between nuclear magnetism and electronic magnetism, there are other differences which are worth noting. Thus, of the three aspects of magnetism, namely, ferromagnetism, diamagnetism, and paramagnetism, only the last is of interest in nuclear magnetism. It will be noted that ferromagnetism may arise when kT, the product of Boltzmann constant and the temperature of the sample, becomes comparable to the couplings between the spins. The strong exchange coupling of electrostatic origin that gives rise to electronic ferromagnetism is absent in nuclear magnetism, and further the magnetic coupling between nuclear spins is such that temperatures of the order of 10^{-7}° K. would be required for a possible observation of nuclear ferromagnetism (or antiferromagnetism). Electronic diamagnetism arises from the Larmor precession of the electronic charges in an applied magnetic field. Such a case is not easy to visualise in nuclear magnetism, and at least in bulk matter it can reasonably be expected to be negligible. Thus we are left with paramagnetism only. Here too, unlike in the case of electronic paramagnetism where there is an appreciable contribution from the orbital motion of the electrons, nuclear paramagnetism is entirely due to the spins of the nuclei and that of orbital origin is of no significance in bulk matter. Again, because of the smallness of the nuclear paramagnetism static methods of measurement as in the case of electronic paramagnetism become too insensitive to bring out the finer points in this field of study. Although a static measurement of nuclear magnetic susceptibility had been made as early as 1937 by Lazarew and Schubnikow, on solid hydrogen at 2° K., nuclear magnetism would probably have remained a simple curiosity if much more sensitive methods using the principle of resonance had not been developed. Now, it may be said that this is the one branch of modern physics where there is very close connection between theory and experiment.

While there are many books on the subject dealing with the practical applications of nuclear magnetism and NMR spectroscopy, those that are devoted to the elucidation of the fundamental aspects of the subject from necessarily a theoretical point of view are indeed few. In this context a theoretical book bringing out the underlying principles of nuclear magnetism will be a most welcome addition to the literature on the subject. The book by Prof. Abragam gives a consistent description of the various aspects of nuclear magnetism on a unified basis. The outlook is mainly theoretical and the book is obviously intended for that category of readers who would like to delve deep into this fascinating field of study. As the author says in the Preface "What I had in mind was to attempt for nuclear magnetism what Van Vleck has done for the theory of electric and magnetic susceptibilities in a book which thirty years after its publication is still *the* book on the subject". The author's expectation is not wrong. *The Principles of Magnetism* will be a book of abiding value on the subject.

* *The Principles of Nuclear Magnetism.* By A. Abragam. (International Series of Monographs on Physics, Oxford at the Clarendon Press), 1961. Pp. xvi + 599. Price (in U.K. only) £ 4·4 *s.* net. Rs. 67·20.

COUMARIN AS THE STIMULATOR OF GROWTH OF ETIOLATED MAIZE STEM TISSUE

J. S. KNYPL AND A. P. DMITRUK
Department of Plant Physiology, University of Lôdz, Lôdz, ul. Narutowicza, 68, Poland

THAT coumarin (*o*-hydroxy-*cis*-cinnamic acid lactone) is a substance with a physiological activity has been known for a long time.[1] At first it has been generally regarded as an inhibitor of seeds germination[2-4] and growth of seedlings, but later some evidence has been gathered that effects induced by this substance depending upon condition, plant genus, kind of tissue, its own concentration, etc.,—might be diverse, and there are well documented findings that coumarin can function as a naturally occurring plant growth regulator.

In 1938 Grace,[5] based on results of his experiments, first concluded that coumarin probably plays a role of an auxin. Some years later Thimann and Bonner,[6] and Gantzer[7] reported that in certain cocentrations coumarin acts synergistically with indole acetic acid (IAA), and finally Neumann,[8] who examined effects of coumarin on the longitudinal elongation of sunflower hypocotyls and similar tissues of other plants, concluded that this substance should be regarded as an auxin,[9] with the mode of action differing from that of IAA and, probably of gibberellin (GA) too.

The growth-promoting action of coumarin is very interesting and, in order to obtain some further evidence of the generality of this phenomenon, we have performed experiments with maize seedlings.

Maize seeds (*Zea mays*, var. Wir. 42), after 3 hours period of soaking in water, were grown in sterilized quartz sand at 26° C. in darkness except for occasional diffused daylight. Five days later, 10 mm. segments were cut from the stem, 5 mm. below the leaf node (the plants in this stage were 5 cm. long) and the sections were floated on distilled water for 2·5 hours, then divided into lots of 15, carefully dried on blotting paper and—after quickly weighing—were floated on surfaces of the test solutions poured into small petri dishes.

In the control sample, instead of coumarin, 10 ml. of distilled water were poured.

After 20 hours period of incubation under diffused fluorescent tube light at room temperature (+ 22·5° C.) the segments were taken out and their increase in weight were measured (preliminary experiments have shown that the increase in weight runs parallel to longitudinal elongation of sections).

From the results presented in Table I it is evident that coumarin significantly accelerates the growth (longitudinal elongation) of sections, and the level of this stimulation depends upon concentration of this substance. In solutions 250 and 500 p.p.m. increase in weight reaches about 255% of control value taken as 100%. The range of concentration of coumarin is optimal—more concentrated solutions produce inhibition and coumarin in 1,000 p.p.m. is toxic for the plant: the longitudinal extension of sections is stopped and at the end of incubation they are flexible, look brownish, and seem to be killed. It is necessary to say that in solution of 500 p.p.m. at the end of 20 hours incubation period the segments are too slightly flexible; additional experiments revealed that the growth rate of sections treated by coumarin is not constant with time—the growth rate reaches its maximum value within the first 4 hours and then it decreases (it was noted that in the first hours of treatment, the growth of sections floated on the surface of 500 p.p.m. coumarin solution was accelerated to about 450% of control, and slight stimulation was observed in 1,000 p.p.m., too).

In the literature there are some evidences supporting the idea that coumarin influences the water relation of plants.[10-12] Therefore, in addition to fresh weight we have also measured the dry weight of samples at the start and at the end of incubation. As in the test solutions there was no sugar or other nutritional compounds—it is clear that the increase in fresh weight of samples must be attributed to absorption of water only, and the dry matter of samples would be reduced as a result of CO_2 output in the respiration. The truth of this *a priori* supposition will be apparent from the following observations (*see* Table I):—In the sample treated with distilled water (control)—in the time of experiment the fresh weight of sections increases from the initial 100 mg. to the final 117 mg., and the percentage of dry matter calculated from the equation:

$$\frac{\text{dry matter}}{\text{fresh weight}} \times 100$$

falls from 5·97 to 5·06; in absolute values the dry matter changes from about 5·97 mg. to 5·93 mg. so that the net loss

Table I

Effect of coumarin in different concentrations on the growth of excised maize stem tissue through 20 hours period of incubation

	Initial values	Concentrations of coumarin, in p.p.m.					
		0 Control	10	50	100	250	500	1000
Fresh weight, mg. ..	100·0	117·1	120·5	121·5	128·2	136·7	137·0	117·0
Increase of fresh weight, in % ..	..	100	120	126	165	215	216	96
Dry matter, mg. ..	5·97	5·93	6·14	6·11	6·10	5·86	5·54	5·23
Change of dry matter, mg. ..	..	−0·04	+0·21	+0·18	+0·07	−0·11	−0·43	−0·74
$\frac{\text{Dry matter}}{\text{fresh weight}} \times 100$	5·97	5·06	5·10	5·03	4·76	4·29	4·05	4·44

All values are average of 6–8 repetitions.

of weight equals 0·04 mg. In the same time in solutions 10, 50 and 100 p.p.m. of coumarin dry matter increases by 0·21 mg., 0·18 mg., and 0·07 mg., respectively, and in more concentrated solutions it significantly decreases (*see* Table I).

Because the rise of fresh weight is accompanied by the decrease in dry matter, it might be concluded that stimulation of growth caused by coumarin is caused—partly at least—by acceleration of water absorption by sections. The increase in dry matter in solutions 10-100 p.p.m. is not clear; but the significant decrease of dry matter at 250 and 500 p.p.m. may be the result of simultaneous stimulation of respiratory activity of tested sections induced by coumarin and more rapid dissimilation of sugars on this way (results not yet published)—solution of 1,000 p.p.m. of coumarin probably additionally kills the tissue and this leads to diffusion of cellular components to the surrounding fluid.

In order to obtain some evidence concerning the mechanism of the growth-promoting activity of coumarin described we performed comparative experiments with indole acetic acid and gibberellin. While the details of these will be published elsewhere, here it is necessary only to say that our results are similar to those reported by Neumann[9] for sunflower hypocotyls and it may be concluded that the nature of coumarin action in promoting the growth of excised maize stem sections differs from that of IAA and GA, but it is doubtful whether coumarin may be named an auxin.

1. Klebs, A., *Die Bedingungen der Fortpflanzung bei einigen Algæ und Pflanzen*, Jena, 1896.
2. Sigmund, W., *Biochem Z.*, 1914, **62**, 339.
3. Kuhn, R., Jerckel, D, Moewus, F., Moller, E. F. und Lettre, H., *Naturwiss.*, 1943. **31**, 468.
4. Evenari, M., *Symp. Soc. Exp. Biol.*, 1957, No. 11, 21.
5. Grace, N. H., *Canad. J. Res.*, 1938, **16C**, 143.
6. Thimann, K. V. and Bonner, W. D., *Proc. U.S. Natl. Acad. Sci.*, 1949, **35**, 272.
7. Gantzer, E., *Planta*, 1960, **55**, 235.
8. Neumann, J., *Science*, 1959, **129**, 1675.
9. —, *Physiol. Plantarum*, 1960, **12**, 328.
10. Guttenberg, H. und Beythien, A., *Planta*, 1952, **40**, 36.
11. Blaim, K., *J. Exp. Botany*, 1960, **11**, 377.
12. Knypl, J. S., *Naturwiss.*, 1960, **47**, 524.

NUCLEI FOR RAIN FORMATION

INTERESTING evidence has been obtained on the possible origin of the minute, mysterious, and so far, unidentified particles whose presence in the atmosphere is vital to the formation of rain from supercooled cloud. This has resulted from a study of samples collected at high altitudes by U-2 aircraft operated by the U.S. Air Force from a base near Sale, Victoria. Thanks to the generous co-operation of the U.S. authorities, special dust-collecting filters were fitted to the U-2 aircraft. Samples of dust present at heights of 50,000–60,000 feet were obtained from ocean areas well to the south of Australia.

The results show unmistakably that substantial numbers of particles occur at these high altitudes—very many more than can be accounted for if they all come from the Earth's surface. Support is thus given to a theory first advanced by Dr. E. G. Bowen in 1953 that an important source of these particles is the meteor dust which the earth picks up, in the course of its annual journey round the Sun, as it intersects the orbits of the various well-known streams of meteors. This meteoritic dust takes some 30 days to sink to the cloud-bearing levels of the atmosphere, and stimulates heavy rainfall when it arrives there if meteorological conditions happen to be favourable.

STUDIES IN THE ENZYME MAKE-UP OF *ALTERNARIA*

I. Qualitative Demonstration of Enzymes

S. N. DAS-GUPTA* AND J. P. VERMA
Department of Botany, Lucknow University
Lucknow

ABSTRACT

Experiments were conducted with three phytopathogenic species of *Alternaria* to find out their enzyme make-up. The presence of a large number of enzymes has been demonstrated in the three species. Phosphorylase, aldolase, dehydrogenases, amidases, deaminases, ribonuclease, nucleodeaminases, glycerophosphatase and nucleophosphatases have been shown to be present in *Alternaria* for the first time.

A LIMITED aspect of enzyme system of *Alternaria* has received attention from previous workers (Szelenyi and Beeze, 1928; Uppal *et al.*, 1938; Tandon and Srivastava, 1949; Coulson and Cinq-Mars, 1952; Torikata and Komai, 1952; Franke and Taha, 1952; Ozawa, 1952; Ozawa and Okamoto, 1953; Pomeranz, 1957; Meyers and Reynolds, 1959). The present series of investigations were undertaken with a view to elucidate the enzyme make-up of three authenticated species of *Alternaria*, viz., *A. tenuis* auct. sensu Wilshire (AT), *A. brassicola* (Schw.) Wiltshire (AB) and *A. raphani* Groves and Skolko (AR), isolated from their respective hosts *Althea rosea*, *Brassica oleracea* and *Raphanus sativus*. Of these *A. tenuis* has already been worked out (Tandon and Srivastava, 1949; Coulson and Cinq-Mars, 1952; Pomeranz, 1957; Meyers and Reynolds, 1959) though only briefly, whereas the other two species are metabolically unknown. The underlying idea behind these studies was to find out the possible correlation between the enzyme make-up of these strains and their pathogenicity. In this first paper of the series an account is given of the enzymes detected by means of qualitative procedures.

Pure monohyphal cultures of these species were utilized for investigation and periodically tested for purity. For the preparation of extra- and intracellular enzyme extracts, mycelia from young cultures (Brown, 1915) were utilized, as being the stage when maximum enzyme production is known to occur. The medium used to grow the fungi was that developed by Ashour (1954). For the preparation of enzymes the spores from each of the species were separately collected from their cultures by repeated floodings with sterile double glass-distilled water and centrifugations. 4 ml. of suspension thus made, having spore content roughly to the order of 4×10^5, were utilized to inoculate each flask containing 21 ml. of the medium, and incubated at 28° C. for 6 days, when a thin mat of young mycelium appeared. The contents of the flasks were then centrifuged at 5° C. at 3,000 rpm. for 30 minutes and the supernatants, stored with a layer of toluene in deep-freeze at — 20° C., served as the extracellular enzyme extract.

The fungal mycelia, washed free of adhering media, were partially dried between folds of sterilized filter-papers and finally in a vacuum desiccator under vacuum and over calcium chloride. The dried mycelia were mixed with an equal quantity of acid-washed sand and crushed in glass pestles and mortars to yield fine powders, which were stored under dry conditions in deep-freeze.

For the extraction of enzymes, 0·2 gm. of the powder containing 0·1 gm. of the fungus material and 0·1 gm. of sand were suspended in 10 ml. of water or buffer at 4° C. with periodical shaking. After 16 hours the solutions were centrifuged at 3,500 rpm. for 20 minutes at 5° C., and the clear supernatants were directly used as the intracellular enzyme source. The presence of the enzymes in the intra- and extracellular extracts was tested by the usual procedures (the actual methods followed in each case have been referred to in appropriate places). Two types of controls, one with inactive enzyme (inactivated by autoclaving at 15 lb. for 15 minutes) and the other with sterile distilled water, were prepared for comparison with the tests. The results, where the enzymes have been grouped following the system adopted by Colowick and Kaplan (1955), are given in Table I.

The table shows the presence of a large number of enzyme systems and records for the first time the presence of phosphorylase, aldolase, dehydrogenases, amidases, deaminases, ribonuclease, nucleodeaminases, glycerophosphatase and

* Present Address: Vice-Chancellor, University of Kalyani, Kalyani, Nadia, West Bengal.

TABLE I

Qualitative demonstration of enzymes

	Enzyme	Substrate	Incubation time and temperature	Enzyme activity						Method
				Intracellular			Extracellular			
				AT	AB	AR	AT	AB	AR	
I	*Carbohydrate metabolism*									
1	Amylase	Starch (5%)	24 hrs. at 37° C.	+	+	+	+	+	+	Fehling's solution
2	Invertase	Sucrose (1%)	do.	+	+	+	+	+	+	do.
3	Raffinase	Raffinase (1%)	do.	+	+	+	+	+	+	do.
4	Hemicellulase	Hemicellulose (Nutman, 1929) (1%)	do.	+	+	+	+	+	+	do.
5	Maltase	Maltose (1%)	do.	+	+	+	+	+	+	Barfoed's reagent
6	Cellulase	Filter-paper	15 days at 37° C.	+	+	+	+	+	+	Maceration
7	Protopectinase	Potato discs	½–20 hrs. at 37° C.	+	+	+	+	+	+	do.
8	Phosphorylase	Glucose 1-phosphate (0·5%)	1 hr. at 37° C.	+	+	+	Not done			Sumner *et al.* (1944, 1950)
9	Aldolase	Fructose-1 : 6-diphosphate (M/20)	do.	+	+	+	do.			Sibley and Lehninger (1949)
II	*Lipid metabolism*									
1	Lipase	Olive oil emulsion	7 days at 37° C.	+	+	+	+	+	+	Titration
2	Butyrase	Ethyl acetate (2%)	3 days at 37° C.	+	+	+	+	+	+	do.
III	*Citric acid cycle*									
1	Dehydrogenases	Succinic acid	16 hrs. at 37° C.	+	+	+	Not done			Srikantan and Murti (1955)
		Aspartic acid	do.	+	+	+	do.			do.
IV	*Protein metabolism*									
1	Proteolytic enzyme	Peptone (2%)	24 hrs. at 37° C.	+	+	+	+	+	+	Formal titration
2	Erepsin	Casein (1%)	7 days at 28° C.	Not done			+	+	+	Medium around the fungal colonies became cleared
3	Rennatase	Milk (fresh)	24 hrs. at 37° C.	+	+	+	+	+	+	Coagulation
4	Urease	Urea (1%)	7 days at 37° C.	+	+	+	+	+	+	Ammonia aerated off and estimated by titration
5	Amidases and Deaminases	*l*-glutamic acid (M/100)	90 mts. at 37° C.	+	+	+	Not done			Liberated ammonia estimated by nesslerization
		dl-glutamic acid (M/50)	do.	+	+	+	do.			do.
		l-glutamine (M/100)	do.	+	+	+	do.			do.
		l-histidine (M/100)	do.	+	+	+	do.			do.
		dl-histidine (M/50)	do.	+	+	+	do.			do.
		d-histidine (M/100)	do.	+	+	+	do.			do.
		dl-asparagine (M/50)	do.	+	+	+	do.			do.
		dl-aspartic acid (M/50)	do.	+	+	+	do.			do.
		l-Asparagine (M/100)	do.	+	+	+	do.			do.
V	*Nucleic acid metabolism*									
1	Ribonuclease	Yeast RNA (4 mg./ml.)	2 hrs. at 37° C.	+	+	+	do.			Formation of pentoses estimated by Brown's (1946) orcinol reaction
2	Nucleodeaminases	Adenine (M/100)	do.	+	+	+	do.			Nesslerization
		Guanine (M/100)	do.	+	+	+	do.			do.
		Xanthine (M/100)	do.	+	+	+	do.			do.
		Uracil (M/100)	do:	−	−	−	do.			do.
		AMP (M) (M/100)	do.	+	+	+	do.			do.
		AMP (Y) (M/100)	do.	+	+	+	do.			do.
		GMP (M/100)	do.	+	+	+	do.			do.
		CMP (M/100)	do.	+	+	+	do.			do.
		ATP (M/100)	do.	+	+	+	do.			do.

(TABLE-I—*Contd.*)

TABLE I—*Contd.*

	Enzyme	Substrate	Incubation and temperature	Enzyme activity: Intracellular AT	AB	AR	Extracellular AT	AB	AR	Method
VI	*Phosphate metabolism*									
	1 Glycerophosphatase	Na-β-glycerophosphate (0·5%)	1 hr. at 37° C.	+	+	+	Not done			Phosphorus estimated (Sumner, 1944)
	2 Nucleophosphatases	AMP (M) (M/100)	2 hrs. at 37° C.	+	+	+	do.			do.
		ATP (M/100)	do.	+	+	+	do.			do.
		GMP (M/100)	do.	+	+	+	do.			do.
		CMP (M/100)	do.	+	+	+	do.			do.
VII	*Respiratory enzymes*									
	1 Catalase	Hydrogen peroxide (1%)	2 hrs. at 15° C.	+	+	+	+	+	+	Titration by $KMnO_4$
	2 Oxidases and peroxidases	Tincture of guaicum (2·5%) and H_2O_2	4-24 hrs. at 37° C.	+	+	+	+	+	+	Colour change
	3 Laccase ..	Hydroquinone (1%)	16 hrs. at 37° C.	+	+	+	+	+	+	do.
	4 Tyrosinase ..	Tyrosine (saturated solution)	48 hrs. at 37° C.	−	−	−	−	−	−	do.

+ denotes the presence of enzyme; − denotes the absence of enzyme.

nucleophosphatases, using various substrates, in the three species of *Alternaria* studied. Rennatase, laccase, oxidase and peroxidase, earlier reported to be absent in the enzyme preparations of *A. tenuis* (Tandon and Srivastava, 1949), were found to be present in significant quantities in the present investigations. These qualitative studies showing significant activities of various enzyme systems give encouraging possibilities for quantitative investigations with regard to the distribution and kinetics of these enzymes in the species of *Alternaria*, which in turn may lead to a possible correlation between the enzyme activity and pathogenicity of these organisms possessing a wide host range. The results of such studies will be published soon.

1. Ashour, W. E., *Trans. Brit. Mycol. Soc.*, 1954, **37**, 343.
2. Brown, A. H., *Biochem. J.*, 1946, **60**, 39.
3. Brown, W., *Ann. Bot.*, 1915, **29**, 313.
4. Coulson, J. G. and Cinq-Mars, L., *In Thirty-second and Thirty-third Reports of the Quebec Society for the Protection of Plants* (1950 and 1951), 1952, pp. 232; Also in *Rev. Appl. Mycol.*, 1954, **33**, 467.
5. Colowic, N. O. and Kaplan, S. P., *Methods in Enzymology*, Academic Press, New York, 1955, **1**, **2**, **3** and **4**.
6. Franke, W. and Taha, E. E. M., *Chem. Berlin*, 1952, **85**, 913; Also in *Biol. Absts.*, 1954, **28**, 14665.
7. Meyers, S. P. and Reynolds, E. S., *Canadian J. Microbiol.*, 1959, **5**, 493.
8. Nutman, F. J., *Ann. Appl. Biol.*, 1929, **16**, 40.
9. Ozawa, J., *Rept. Ohara Inst. Agr. Research*, 1952, **40**, 110.
10. — and Okamoto, K., *Ibid.*, 1953, **41**, 17; Also in *Chem. Absts.*, 1953, **47**, 10070.
11. Pomeranz, Y., *Bull. Research Council Israel*, 1957, **6C**, 53; Also in *Chem. Absts.*, 1958, **52**, 3032.
12. Sibley, J. A. and Lehninger, A. L., *J. Biol. Chem.*, 1949, **177**, 859.
13. Srikantan, T. N. and Murti, C. R. K., *J. Sci. Ind. Res.*, 1955, **14C**, 206.
14. Sumner, J. B., *Science*, 1944 **100**, 413.
15. — Chou, J. C. and Bever, A. T., *Arch. Biochem.*, 1950, **26**, 1.
16. Szelenyi, G. V. and Beeze, G. V., *Rev. Appl. Mycol.*, 1928, **8**, 263 (1929).
17. Tandon, R. N. and Srivastava, J. P., *Proc. Natl. Acad. Sci. India*, 1949, **19 B**, 13.
18. Torikata, H. and Komai, Y., *Ann. Phytopathol. Soc. Japan*, 1952, **16**, 63; Also in *Chem. Absts.*, 1953, **47**, 9433.
19. Uppal, B. N., Patel, M. K. and Kamat, M. N., *Ind. J. Agric. Sci.*, 1938, **7**, 413.

LETTERS TO THE EDITOR

DISSYMMETRY MEASUREMENTS OF HIGH POLYMER SOLUTIONS AT HIGH DILUTIONS

It is known that for small molecules the scattering intensity at two angles (I_θ, $I_{\pi-\theta}$) equally spaced about 90° is the same. This is no longer so when the size of the molecule becomes comparable to that of the wavelength of the light, because the light scattered from different parts of the molecule interferes hence the intensities are different in different directions. Thus there is a dissymmetry in the scattered light. The dissymmetry coefficient q is defined as

$$q = \frac{I_\theta}{I_{\pi-\theta}} - 1 \qquad (1)$$

where I_θ and $I_{\pi-\theta}$ are the excess of scattering intensity at angles θ and $\pi - \theta$ due to solute. To find the size of the molecule in solution it is the usual practice to find q at different concentrations (i.e., 0·1 gm./100 c.c. to about 0·3 gm./100 c.c.) and the intrinsic dissymmetry coefficient $[q]$ (the value of q at $C = 0$) is obtained by linear extrapolation of $1/q$ *vs.* C graph to $C = 0$ From the knowledge of $[q]$ the length of the molecule is evaluated by well-known formula.

If the size and concentration are the only factors affecting the dissymmetry, the dissymmetry should tend to attain a constant value, below a certain concentration where the concentration contribution may become negligible. As a consequence in the plots of $1/q$ against 'C' the portion of the curve at low concentrations should tend to be parallel to the C-axis. Recently[1-4] it has also been reported by many workers that the viscosity number η_{sp}/c of a polymer solution increases with decreasing concentration below a certain critical concentration (0·1%). This was explained by Torukawai *et al.*,[5] by taking into consideration the expansion of polymer coil with dilution below a certain concentration. If this is the case an analogous effect should be observed with light scattering dissymmetry and hence with the graph $1/q$ *vs.* C at lower concentration region. Consequently the customary procedure of linear extrapolation of $1/q$ *vs.* C graph to $C = 0$ to obtain the size of the molecule is not entirely justifiable. Frank[6] had shown in respect of Polystyrene that such an analogous effect did not exist in light scattering behaviour. However in view of continued reports of viscosity abnormalities[5] and the large scatter of experimental data at low concentrations reported by Frank it is thought desirable that an investigation of dissymmetry of polymer solutions at very low concentrations where the scattering due to solution is comparable to that of the solvent should be undertaken to establish the validity or otherwise of the dissymmetry method.

Two narrow fractions of polymethyl methacrylate (PMM) one of high molecular weight (H) ($M_w = 1{\cdot}14 \times 10^6$) were taken. Ethyl acetate was taken as a solvent because for this system the dn/dc is high (0·120), hence reliable results can be obtained. The light scattering data were observed at different concentrations between (0·4 gm./100 c.c. to 0·009 gm./100 c.c.) and for each concentration at the angles 45°, 90° and 135°. The readings are shown in Table I

TABLE I

Light scattering data for fractions H and L

Fraction H Conc. gm./100 c.c.	$1/q$	Fraction L Conc. gm./c.c.	$1/q$
·0092	1·63	·0208	8·85
·0136	1·83	·0357	10·99
·0201	1·96	·0612	10·99
·0297	1·86	·1050	11·90
·0438	2·13	·1800	12·99
·0647	2·17	·1960	14·08
·0955	2·38	·2240	14·49
·1409	3·01	·2690	15·62
·2080	3·27	·3420	17·56
·2290	3·55	·4160	19·23
·3300	5·21	..	..
·4240	7·09	..	..
·4600	7·19	..	..

and the graphs plotted between $1/q$ and C are shown in Fig. 1.

From the graphs it is evident that the linear relationship between $1/q$ and C holds good up to the lowest concentration ·009 gm./100 c.c. within the limits of experimental errors. This is not an expected result and it looks as though a new factor affecting the dissymmetry of the molecule begins to operate at very low dilution. Or it may be that the concentration contribution to dissymmetry is still finite even at concentrations as low as 0·0092 gm./100 c.c. In either case an effect analogous to the abnormal viscosity behaviour at low concentrations does not seem to exist in the light scattering pattern. However, the results justify the conventional method of

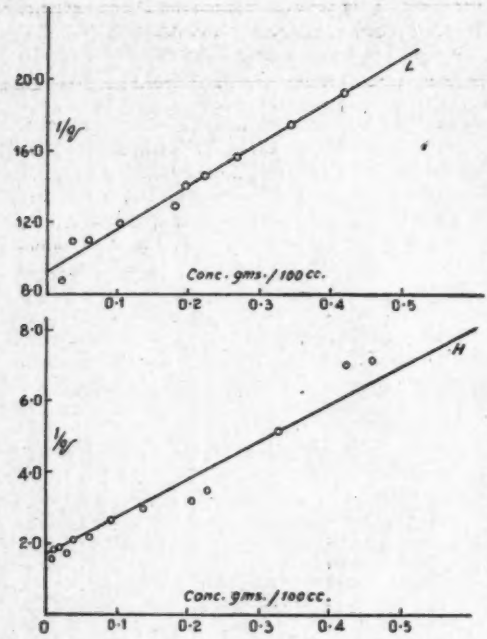


FIG. 1. Reciprocal dissymmetry coefficient ($1/q$) *versus* concentration. PMM—Ethyl Acetate.

extrapolating $1/q$ *vs.* C graph to $C = 0$ to obtain the size of the molecule.

Physics Department, Osmania University, Hyderabad-7 (A.P.), India,
September 14, 1960.

V. V. VARADAIAH.
V. S. R. RAO.

1. Streeter, D. J. and Boyer, R. F., *J. Polymer. Sci.*, 1954, **14**, 5.
2. Batzer, H., *Makromol. Chem.*, 1954, **12**, 145.
3. Umstalter, H., *Ibid.*, 1954, **12**, 94.
4. Patat, F. and Elias, H. G., *Ibid.*, 1954, **16**, 40.
5. Torukawai and Kazuhisa Saito, *J. Polymer Sci.*, 1957, **26**, 213.
6. Frank, H. P., *Ibid.*, 1955, **17**, 130.

ULTRASONIC VELOCITY IN SOME INORGANIC SOLUTIONS AND MELTS

IT is known that in many organic solute-solvent systems,[1] the plots of sound velocity *vs.* percentage weight of the solute are linear. In such cases the velocity for 100% of the solute can be evaluated by extrapolation of the linear graphs. It has been found[2] that, in the case of some organic substances with low melting temperatures, the extrapolated value is independent of the solvent and corresponds to the velocity in the liquid phase at the melting point. When such a procedure is adopted in the case of some inorganic substances[3] (alkali halides and nitrates with high melting points), the extrapolated value is found to be very much higher than the velocity in the melt. This discrepancy has been attributed to the large difference between the temperatures at which these substances exist as liquids and the room-temperature at which the data on solutions are collected. To clarify this point further, it is proposed to study the sound velocities in aqueous solutions of some low melting inorganic substances (hydrated salts) and correlate the results with the sound velocities in their melts.

A variable-path interferometer working at 720 Kcs. has been employed to determine the ultrasonic velocity. The estimated error in velocity measurement is $\pm 0{\cdot}15\%$. Measurements on solutions are made at $30 \pm 0{\cdot}5°$ C.

The variation of ultrasonic velocity with percentage weight of the solute for aqueous solutions of sodium thiosulphate, potassium sodium tartrate and calcium nitrate is shown in Fig. 1. The velocity varies linearly in all cases.

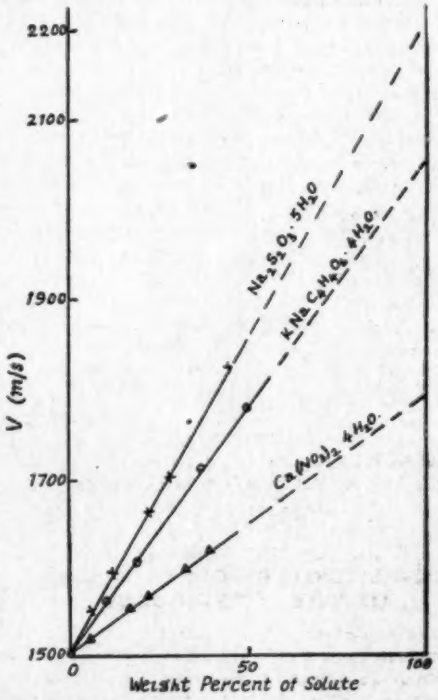


FIG. 1. Variation of ultrasonic velocity in aqueous solutions of $Na_2S_2O_3.5H_2O$, $KNaC_4H_4O_6.4H_2O$ and $Ca(NO_3)_2.4H_2O$.

The linear plots are extrapolated to get the velocity corresponding to 100% of the solute. The values of the velocity so obtained are given in column 2 of Table I. These values are compared with the sound velocities in the corresponding melts at the melting point.

TABLE I

Ultrasonic velocities in solutions and melts

Substance	Ultrasonic velocity in m./sec.	
	From solution data	At the melting point
$Na_2S_2O_3 \cdot 5H_2O$ ..	2192	2176 (45° C.)
$KNaC_4H_4O_6 \cdot 4H_2O$ ..	2040	2052 (75° C.)
$Ca(NO_3)_2 \cdot 4H_2O$ ..	1790	1800 (50° C.)

Ultrasonic velocity in the molten sodium thiosulphate has been determined in the present investigation and the data for the other two substances are taken from the work of Padmini and Rao.[4] Comparison of columns 2 and 3 shows that the characteristic velocities obtained from the data on solutions correspond to the velocities at the melting points of the substances. This result is in agreement with our earlier observations.[2]

In the case of substances with high melting points, a study of a temperature-independent property like molar sound velocity[3] may be helpful.

The author takes this opportunity to thank Dr. J. Bhimasenachar for his encouragement.

Department of Physics, S. V. SUBRAHMANYAM.
S.V. University,
Tirupati, *October* 28, 1961.

1. Schaffs, W., *Z. physik.*, 1937, **105**, 658.
2. Subrahmanyam, S. V. and Bhimasenachar, J., *J. Acoust. Soc. Am.*, 1960, **32**, 703.
3. — and —, *J. Phys. Soc. Japan*, 1961, **16**, 1447.
4. Padmini, P. R. K. L. and Ramachandra Rao, B., *Nature*, 1961, **191**, 694.

DIAMAGNETIC SUSCEPTIBILITIES OF SOME ISOMERIC MONOSUBSTITUTED NITROBENZENES—EFFECT OF THE POSITION OF THE SUBSTITUENT GROUP ON SUSCEPTIBILITY AND THE SUSCEPTIBILITY CONTRIBUTION OF THE NITRO-GROUP

THE effect of the nature and position of a substituent on the susceptibility of isomeric disubstituted benzenes has been examined by several investigators notably by French,[1] Kido,[2] Cabrera and Fahlenbrach,[3] Bhatnagar and Mathur,[4] and Khatavkar and Khanolkar.[5] The results tend to indicate that the susceptibilities of these position isomers, although different from each other, do not show any definite order among themselves. French[1] has drawn attention to the anomalous effect on the susceptibility of a compound due to the presence of a nitro-group, there being an appreciable difference between the susceptibilities of isomers when a nitro-group is one of the substituents and when this group is absent. In the present investigation susceptibilities of a large number of monosubstituted nitrobenzenes have been examined with a view to study the effect of the position of the substituent group on the susceptibility of the compound and to determine the susceptibility contribution of the NO_2-group in these isomerides.

EXPERIMENTAL

All materials used in the present investigation were purified using all-glass apparatus. Solids of B.D.H. pure grade were purified by recrystallisation from pure suitable solvents and their purity was checked by determining their melting points and comparing them with those reported in the literature. Liquids of the same grade were twice redistilled and their purity

TABLE I

Compound	χ	χ_m	$\Delta\chi_m$
Toluene ..	..	64·74	..
o-Nitrotoluene ..	0·527	72·19	7·45
m-Nitrotoluene ..	0·530	72·61	7·87
p-Nitrotoluene ..	0·510	69·87	5·13
Chlorobenzene ..	..	70·53	..
o-Chloronitrobenzene ..	0·512	80·65	10·12
m-Chloronitrobenzene ..	0·483	76·07	5·54
p-Chloronitrobenzene ..	0·505	79·54	9·01
Phenol ..	..	60·70	..
o-Nitrophenol ..	0·505	70·20	9·50
m-Nitrophenol ..	0·472	65·60	4·90
p-Nitrophenol ..	0·456	63·39	2·69
Anisole ..	..	71·97	..
o-Nitroanisole ..	0·492	75·28	3·31
m-Nitroanisole ..	0·520	79·56	7·59
p-Nitroanisole ..	0·518	79·25	7·28
Aniline ..	..	62·69	..
o-Nitroaniline ..	0·481	66·37	3·68
m-Nitroaniline ..	0·491	67·76	5·07
p-Nitroaniline ..	0·480	66·24	3·55
Acetanilide ..	..	82·62	..
o-Nitroacetanilide ..	0·514	92·53	9·91
m-Nitroacetanilide ..	0·457	84·07	1·45
p-Nitroacetanilide ..	0·486	87·48	4·86
Benzaldehyde ..	..	59·99	..
o-Nitrobenzaldehyde ..	0·475	71·73	11·74
m-Nitrobenzaldehyde ..	0·446	67·35	7·36
p-Nitrobenzaldehyde ..	0·433	65·39	5·40

checked by determining their boiling points and refractive indices. *m*-Nitroacetanilide and *m*-Nitroanisole were prepared using standard methods of preparation; they were purified and their purity checked by their melting points.

Magnetic susceptibilities were measured by a modified form of Guoy balance described by Prasad *et al.*[6] The error of measurement was found to be less than 1%. These values are given in Table I, wherein χ and χ_m denote the specific and molar susceptibilities respectively, expressed in -1×10^{-6} C.G.S. Units. The susceptibility contribution of the nitro-group in the isomers has been determined by calculating the differences between the magnetic susceptibilities of substituted nitro-derivatives and of the corresponding parent substances. The values of χ_m for the parent substances required for this purpose were determined by the authors. The χ_m value for phenol in Table I, however, has been taken from literature. The $\Delta\chi_m$ values $[\chi_m(\rightarrow C-NO_2)-\chi_m(\rightarrow C-H)]$ are given in the last column of Table I.

Discussion

According to French[1] in disubstituted benzene derivatives the susceptibility of the ortho compound has the highest value when two electron repelling substituents are in ortho position to each other. In compounds containing two electron attracting substituent groups the susceptibility of the meta compound has the highest magnitude. She has attributed this to the differences in the distribution of the electron density at the ortho and meta positions respectively due to the presence of these substituents in the benzene nucleus. Among the seven monosubstituted nitrobenzenes studied in this investigation the nitrobenzaldehydes are the only ones containing electron withdrawing substituents. The susceptibility of the meta isomer in these compounds should be the highest according to considerations referred to above. The observed values of χ_m, however, do not support these views. In the remaining sets of isomeric monosubstituted nitrobenzenes no definite order emerges from the observed χ_m values. For nitroanilines the results confirm the order *m*>*o*>p obtained by Mikhail.[7]

A critical examination of the results indicates that the magnitude of the difference in the susceptibilities of *o*- and *m*-compounds is of the order of 4·5 units in several cases.

French[1] has observed an *o*-*m* difference of the same order in the case of dinitrobenzenes and nitrobenzoic acids. In nitroacetanilides, however, this difference is as high as eight units. Again the magnitude of the difference between *m*- and p-, and *o*- and *p*-compounds is relatively smaller. The results tend, in general, to confirm anomalous effects observed by French[1] and other investigators including Pascal in the case of compounds containing the nitro-group.

The values of $\Delta\chi_m$ (Table I) show that the susceptibility contribution of the nitro-group varies from 1·45 to 11·74 but ranges from 3·5 to about 8 for a majority of the substituents. Although the magnitude of this value is highest in the meta position for the nitro-toluenes and nitroanilines as found by Badder and Sugden,[8] the same order cannot be extended to other nitro-derivatives. In the case of isomeric nitro-derivatives containing the Cl, OH, $NHCOCH_3$ and CHO substituents $\Delta\chi_m$ values are not only the highest but substantially higher (9·5 to 11·74 units) than the average range for the *o*-isomers.

An attempt was also made to correlate the magnetic susceptibility of the monosubstituted nitrobenzenes with physical properties such as density, boiling point, refractive index, molecular volume, etc., and also with the size of the substituent. An examination of the results failed to establish any close relationship between magnetic susceptibility and these properties.

The authors wish to thank Dr. D. D. Khanolkar, Institute of Armaments Studies, Kirkee, Poona-3, for initiating the problem and directing some of the experimental work.

Chemistry Department, Institute of Science, Bombay, *May* 20, 1961.

S. M. Shah.
R. N. Merchant.
M. G. Datar.

1. French, *Trans. Faraday Soc.*, 1945, **41**, 676.
2. Kido, *Sci. Rep. Tohoky Imp. Univ.*, 1936, **24**, 701.
3. Cabrera and Fahlenbrach, Z., *Physik.*, 1934, **89**, 682.
4. Bhatnagar and Mathur, *Phil. Mag.*, 1930, **10**, 101; 1931, **11**, 914.
5. Khatavkar and Khanolkar, *Jour. of Sci. Ind. Res.*, 1959, **8 B**, 25.
6. Prasad *et al.*, *Proc. Indian Acad. Sci.*, 1944, **20 A**, 224.
7. Mikhail, *J. Chem. Phys.*, 1953, **21**, 1004.
8. Badder and Sugden, *J. Chem. Soc.*, 1950, p. 308.

MAGNETISM AND MOLECULAR STRUCTURE: THE ESTIMATE OF METAL-NITROGEN BOND IN CADMIUM CHLORIDE COMPLEXES OF ORGANIC BASES

In continuation of our previous work on zinc chloride complexes of organic bases reported in this journal[1] we now submit the results of the

study of complexes of cadmium chloride with the same organic bases.

The method of preparation and the measurement of magnetic susceptibilities of these complexes is the same as described in the previous work. The results are given in Tables I A and I B.

TABLE I A

	Name of the complex	χ	χ_m	Name of Ligand	χ_m
1	Dipyridine cadmium chloride ..	0·457	156·00	Pyridine	46·92
2	Diquinoline cadmium chloride ..	0·526	232·30	Quinoline	87·52
3	(i) Dianiline cadmium chloride-dihydrate ..	0·511	(i) 207·20	Aniline	62·55
	(ii) Anhydrous ..		(ii) 186·26		
4	(i) Ditoluidine cadmium chloride-dihydrate (*Ortho*)	0·546	(i) 236·50	*o*-toluidine	74·54
	(ii) Anhydrous ..		(ii) 215·56		
5	Ditoluidine cadmium chloride (*Meta*) ..	0·503	199·90	*m*-toluidine	74·40
6	do. (*Para*) ..	0·515	204·70	*p*-toluidine	72·58
7	Dixylidine cadmium chloride (*Meta*) ..	0·545	232·00	*m*-xylidine	86·90
8	Diamine cadmium chloride ..	..	100·01	Ammonia (liquor)	19·00

TABLE I B

Complex	χ_m	$\Delta\chi_m$	Ligand	$\chi_{m'}$	$\Delta\chi_{m'}$	$\frac{\Delta\chi_m - \Delta\chi_{m'}}{2}$ = λ per Cd-N bond
$CdCl_2.2\,C_5H_5N$ ..	156·00	55·99	$2\,C_5H_5N$	93·84	55·84	+0·07
$CdCl_2.2\,NH_3$ ..	100·01		$2\,NH_3$	38·00		
$CdCl_2.2\,C_9H_7N$ ..	232·30	132·29	$2\,C_9H_7N$	174·04	137·04	−2·37
$CdCl_2.2\,NH_3$ ..	100·01		$2\,NH_3$	38·00		
$CdCl_2.2\,C_6H_5NH_2$ ..	186·26	86·25	$2\,C_6H_5NH_2$	125·10	87·10	−0·42
$CdCl_2.2\,NH_3$ ..	100·01		$2\,NH_3$	38·00		
$CdCl_2.2\,C_7H_7NH_2$ (*Ortho*)	215·56	115·55	$2\,C_7H_7NH_2$ (*Ortho*)	149·08	111·08	+2·23
$CdCl_2.2\,NH_3$ ..	100·01		$2\,NH_3$	38·00		
$CdCl_2.2\,C_7H_7NH_2$ (*Meta*)	199·90	99·89	$2\,C_7H_7NH_2$ (*Meta*)	148·80	110·80	−5·45
$CdCl_2.2\,NH_3$ ..	100·01		$2\,NH_3$	38·00		
$CdCl_2.2\,C_7H_7NH_2$ (*Para*)	204·70	104·60	$2\,C_7H_7NH_2$ (*Para*)	145·16	107·16	−1·23
$CdCl_2.2\,NH_3$ ..	100·01		$2\,NH_3$	38·00		
$CdCl_2.2\,C_8H_9NH_2$ (*Meta*)	232·00	131·99	$2\,C_8H_9NH_2$ (*Meta*)	173·80	135·80	−1·90
$CdCl_2.2\,NH_3$ ..	100·01		$2\,NH_3$	38·00		

It is seen from the results that the λ values are positive in some cases and negative in others. In the study of zinc chloride complexes with organic bases[2] it was pointed out that the observed values of magnetic susceptibilities were always lower than their experimentally computed ones assuming strict additivity. The deviations from additivity were attributed to the changes in the χ_d and χ_p terms of Van Vleck's equation, as a result of the combination of the anhydrous salt with the ligand. It is obvious that the λ values in this case also include effects due to changes in χ_d and χ_p terms in these complexes as compared to the corresponding contribution in diamine. The positive values of λ indicate that changes in χ_d term arising from Cd-N bond in the pyridine and the *ortho*-toluidine complexes as compared to the Cd-N in the diamine are more significant than the corresponding changes in χ_p term. The λ values tend to become more negative in the order *o*-toluidine > pyridine > aniline > *p*-toluidine > *m*-xylidine > quinoline > *m*-toluidine. This order is similar to that observed for zinc chloride complexes except for *m*-toluidine and *m*-xylidine.

Department of Chemistry, V. G. SONALKAR.
Institute of Science, M. G. DATAR.
Bombay-1, *July* 6, 1961.

1. Datar and Sonalkar, *Curr. Sci.*, 1960, **29**, 468.
2. — and —, *J. Univ. Bombay*, November issue (In press).

GRAVIMETRIC DETERMINATION OF CERIUM (IV) AND ITS SEPARATION FROM RARE-EARTHS USING 1-HYDROXY XANTHONE

A NUMBER of organic reagents[1-3] have been recommended for the gravimetric estimation of Cerium (IV). However most of these do not

separate it conveniently from trivalent rare-earths. The Iodate method[4] which is generally used for the estimation and separation of Cerium from other rare-earths involves a number of operations.[5] 3-Acetyl-4-hydroxy Coumarin effectively separates Cerium (IV) from large quantities of lanthanum, yttrium and gadolinium.[6]

1-hydroxy xanthone has been used for the gravimetric determination of uranium and thorium, in presence of Cerium (III) and lanthanum, but not in presence of Cerium (IV).[7] It has now been found that 1-hydroxy xanthone in alcoholic solution, instantaneously forms a yellowish-brown complex with ceric salts, which gets readily separated on dilution with water. This reaction is quantitative between pH 2·0 and 8·5, and quantities as low as 5·0 mg. of CeO_2 have been estimated. The reagent does not form any complex with lanthanum, yttrium and gadolinium and can be used for the separation and estimation of Cerium (IV) from large quantities of these elements.

1% 1-hydroxy-xanthone ethanolic solution was used. Metallic salts were either of A.R. or Pro Analysi quality. Gadolinium nitrate solution was made from Gd_2O_3 (Johnson Mathey). Dilute hydrochloric acid, ammonium acetate and ammonium hydroxide were used for pH adjustment, and pH measurements were taken with a Beckman pH meter using a suitable glass electrode.

Determination of Cerium (IV) with 1-hydroxy xanthone

To 100 ml. of Cerium (IV) ammonium nitrate solution containing about 20 mg. of CeO_2, 25 ml. of alcohol and 10 ml. of 1% ethanolic solution of 1-hydroxy xanthone were slowly added with constant stirring. The yellowish-brown complex thus formed was heated on a water-bath to completely remove alcohol. After cooling, on the addition of water (100 c.c.) the Cerium complex along with the excess of the reagent got precipitated. The flocculent precipitate was filtered through Whatman filter-paper No. 40, washed with water, dried and ignited to CeO_2. The results obtained are given in Table I.

Table I

Wt. of CeO_2 taken (by oxine method) mg.	Wt. of CeO_2 found (by 1-hydroxy xanthone method) mg.
5·0	5·0
11·3	11·3
20·0	20·0
22·4	22·4
40·1	40·0
50·0	50·1

Table I. The sulphate ions interfere in this estimation while chloride and nitrate ions are without any effect.

Effect of pH on the Formation of the Ceric Complex

The effect of pH on the precipitation of the complex was studied by using ammonium acetate-ammonium hydroxide buffer for higher pH and dilute hydrochloric acid for lower pH. It was found that the precipitation of ceric complex is complete between pH 2·0 and 8·5 (Table II).

Table II

Wt. of CeO_2 taken = 20·0 mg.
Wt. of CeO_2 found:

mg.	4·2	9·4	20·0	20·0	20·0	20·0	20·0
pH	1·0	1·5	2·0	3·0	5·0	7·0	8·5

Determination of Cerium IV in the Presence of the Rare-Earths

As the reagent does not form any complex with trivalent rare-earths, the procedure for the determination of Cerium (IV) in their presence is the same as for Cerium (IV) alone. The precipitate before ignition was thoroughly washed with water.

Table III

Estimation of Cerium (IV) in presence of lanthanum (pH 2·0-7·0)

Wt. of CeO_2 taken, mg.	Wt. of La_2O_3 added, mg.	Wt. of CeO_2 found, mg.
20·0	19·9	20·0
20·0	29·8	20·0
20·0	39·8	20·0
20·0	49·7	20·0
20·0	99·5	20·0
20·0	199·0	20·0

Table IV

Estimation of Cerium (IV) in presence of Yttrium (pH 2·0–7·0)

Wt. of CeO_2 taken, mg.	Wt. of Y_2O_3 added, mg.	Wt. of CeO_2 found, mg.
20·0	23·70	20·0
20·0	35·05	20·0
20·0	47·40	20·0
20·0	58·75	20·0
20·0	118·50	20·0
20·0	237·00	20·0

Cerium (IV) can, thus, be estimated in presence of large quantities of Lanthanum, Yttrium and Gadolinium.

TABLE V

Estimation of Cerium (IV) in presence of gadolinium pH (2·0-7·0)

Wt. of CeO_2 taken, mg.	Wt. of Gd_2O_3 added, mg.	Wt. of CeO_2 found, mg.
20·0	20·04	20·0
20·0	30·06	20·0
20·0	40·08	20·0
20·0	50·10	20·0
20·0	100·20	20·0
20·0	200·40	19·8

SUMMARY

1-hydroxy xanthone has been used for the estimation of Cerium (IV) at pH 2·0 to 7·0. As the reagent does not form any complex with other trivalent rare-earths, the estimation of Cerium (IV) can be carried in presence of large quantities of these.

The authors are grateful to Prof. T. R. Seshadri, F.R.S., Head of the Department, for his keen interest and helpful discussions.

Dept. of Chemistry, BRAHM DEV.
University of Delhi, B. D. JAIN.
Delhi-6 (India), *October* 3, 1961.

1. Jefferson A. M., *J. Amer. Chem. Soc.*, 1902, **24**, 540.
2. Pirtea, T., *Bull. Chem. Soc., Romane Chim.*, 1937, **39**, 83; *C.A.*, 1940, **34**, 2277.
3. Jain, B. D. and Singhal, S. P., *J. Sci. Industr. Res.*, 1960, **19 B**, 494.
4. Brinton, P. H. M. P. and James, C., *J. Amer. Chem. Soc.*, 1919, **41**, 1080.
5. Schoeller, W. R. and Powell, A. R., *The Analysis of Minerals and Ores of the Rarer Elements* Charles Griffin & Co., Ltd. (London), Third Ed., 1955, p. 101.
6. Bhat, A. N. and Jain, B. D., *J. less common Metals*, 1961, **3**, 259.
7. Brahm Dev and Jain, B. D., under publication.

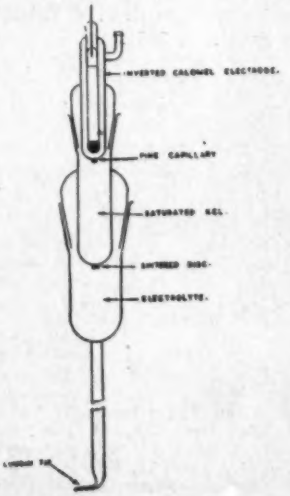
A COMPACT CALOMEL REFERENCE ELECTRODE PARTICULARLY USEFUL IN APPLIED ELECTROCHEMICAL INVESTIGATIONS

A KNOWLEDGE of the potential of a working electrode helps considerably in the understanding of electrochemical processes. The design considerations for a reference electrode are:—(1) reproducibility and constancy of the potential of the reference electrode; (2) minimum contamination of the cell electrolyte and reference electrode arising from diffusion (fritted glass discs, fine capillaries, agar-agar bridges are generally used to cut down diffusion); (3) minimum iR drop (whereas, in polarography, for example, the microampere order of current automatically makes the drop negligible; in cells, where tens or hundreds of milliamperes pass, the drop is considerable, and the reference electrode is, therefore, made to terminate in a fine capillary—"Luggin tip"—which is brought as close to the working electrode as possible).

The agar-agar bridge suffers from two disadvantages:—(*a*) there is a possibility of contaminating the bath with organic impurities; (*b*) instability of the agar-agar comes in the way of high-temperature (> 50° C.) studies.

An alternative method consists in using a 4-unit arrangement—electrolytic cell, one beaker containing cell electrolyte, another beaker containing saturated KCl, and the SCE. The various units are connected with bridges, one of the bridges terminating in a Luggin tip. This arrangement, however, is very unwieldy to manœuvre in applied investigations where cells (generally, large cells) are designed for purposes other than potential measurement. The external bridges are responsible for the lack of manœuvrability. They have been eliminated, in some cases, by choosing a reference electrode employing the same electrolyte as that in the cell. For example, Sanghi and Wynne-Jones[1] used a Hg/HgO/KOH reference electrode in a study of the anodic behaviour of zinc in KOH solutions. This approach, however, is not so useful where a reference electrode has to be designed to work in varied applied investigations. A compact, single, integrated unit incorporating bridge and Luggin tip is essential. One such design is presented below.

The assembly (Fig. 1) consists of an inverted



calomel* electrode (prepared as described by Chilton *et al.*[2] fitted into a tube containing saturated KCl, which in turn fits into a tube containing the cell electrolyte. The saturated KCl tube has a small sintered glass disc to permit electrolyte contact. The tube containing cell electrolyte) terminates in a Luggin tip.

The central KCl tube minimises contamination of the SCE by diffusion of the bath, while the outer tube of electrolyte minimises contamination of the bath by KCl. Since ground-glass joints are employed, mixing of solutions by flow due to differences in level is absent. Further, no suction-filling of the tubes is required.

The above type of reference electrode is very convenient to handle. The potential of the reference electrode remained constant even after its use in a 24-hour electrolysis experiment thereby indicating that practically no contamination occurs.

This design, however, suffers from one drawback. Since a sintered disc and a fine capillary are used, the electrode has a resistance of the order of a few thousand ohms (ten thousand ohms). The resistance depends on the coarseness of the disc and the bore of the capillary. The high resistance necessitates the use of a vacuum-tube voltmeter with a large enough input impedance.

We thank Dr. A. K. N. Reddy, Senior Scientific Officer, for helpful suggestions, and Professor K. S. G. Doss, Director for his interest in the work.

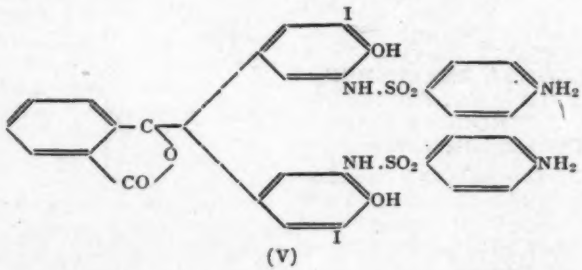
Central Electrochemical Research Institute, Karaikudi, *August* 8, 1961.

S. R. RAJAGOPALAN.
B. V. K. S. R. A. TILAK.

SULPHONAMIDOIODOPHTHALEINS

HALOGENATED organic compounds such as chiniofon,[1] chloroquine,[2] iodophthalein,[3] phenoltetrachlorophthalein,[4] etc., are widely used in medicine and pharmacy. The present work was undertaken to synthesize and study the pharmacological properties of sulphanamidoiodophthaleins.

Phenolphthalein was nitrated with acetic-nitric acid mixture at 10-15° C. to 3′, 3″-dinitrophenolphthalein (I),[5] m.p. 198-99° C. (I) in alkaline solution was iodinated with iodine in potassium iodide to 5′, 5″-diiodo-3′, 3″-dinitrophenolphthalein (II), m.p. 253-55° C. (dec.); yield 84-87%. (Found: C, 36·128; H, 1·631; N, 4·104; I, 38·210. Calc.: C, 36·390; H, 1·526; N, 4·244; I, 38·450. (II) was reduced to 5′, 5″-diiodo-3′, 3″-diaminophenolphthalein (III) which does not melt up to 360° C.; yield 40-41%. (Found: C, 39·820; H, 2·428; N, 4·517; I, 42·060. Calc.: C, 40·020; H, 2·351; N, 4·668; I, 42·290). The amino-compound (III) on condensation with N-acetylsulphanilyl chloride in alcohol acetone mixture (1 : 1) in presence of pyridine yielded 5′, 5″-diiodo-3′, 3″-diacetylsulphanilylamidophenolphthalein (IV) m.p. 228-30° C. (dec.). (Found: C, 43·610; H, 2·681; N, 5·472; S, 6·214; I, 25·700. Cal.: C, 43·470; H, 2·836; N, 5·632; S, 6·448; I, 25·520). (IV) on hydrolysis with 4% aqueous sodium hydroxide gave 5′, 5″-diiodo-3′ 3″-disulphanilylamidophenolphthalein (V), m.p. 210-12° C. (dec.); yield 85-90%. (Found: C, 41·982; H, 2·513; N, 5·940; S, 7·174; I, 28·060. Cal.: C, 42·230; H, 2·657; N, 6·154; S, 7·046, I, 27·880).



(V)

(V) is a colourless, amorphous solid, soluble in alcohol and acetone and insoluble in ether. It dissolves in dilute alkali with a blue colour and in dilute acid with a yellow colour and gives green colour with ferric chloride.

Further work and the pharmacological investigations are in progress. Details of these investigations will be published elsewhere.

* In-tead of an inverted calomel electrode a normal calomel electrode with minimum diffusion can also be used.[3]

1. Sanghi, I. and Wynne Jones, W. F. K., *Proc. Ind. Acad. Sci.*, 1958, **47 A**, 49.
2. Chilton, J. M., Cole, J. W. and Leake, P. H., *J. Chem. Ed.*, 1950, **27**, 560.
3. Delahay, P., *Instrumental Analysis*, The MacMillan Company, New York, 1957, p. 28.

We are thankful to the college authorities for granting us facilities to carry out the work.

Dept. of Pharm. Chem., C. R. MEHTA.
L.M. College of Pharmacy, J. R. KALKE.
Ahmedabad-9, N. B. SHAH.
June 29, 1961.

1. Claus, *German Pat.*, 1892, **72**, 942; 1894, **78**, 880; *Arch Pharm.*, 1893, **231**, 704.
2. Surrey and Hammer, *J. Amer. Chem. Soc.*, 1946, **68**, 113.
3. Goodman, L. S and Gilman, A., *The Pharmacological Basis of Therapeutics* II Edn., MacMillan Company, New York, 1955, p. 1173.
4. Jenkins, G. L. and Hartung, W. H., *The Chemistry of Organic Medicinal Products*, III Edn., John Wiley & Sons, Inc., New York, 1949, p. 243.
5. Van Kampen, E. J., *Rec. Trav. Chim.*, 1952, **71**, 954; through *Chem. Abstr.*, 1953 **47**, 8677.

DISTRIBUTION OF NICOTINAMIDE DEAMIDASE IN GERMINATING PULSES

AN enzyme system capable of deamidating nicotinamide to free nicotinic acid and ammonia was demonstrated for the first time in *Lactobacillai*,[1] yeast[2] and *Mycobacteria*[3] and later in *Neurospora crassa*[4] and the rice moth larva[5] and recently in pea seedlings.[6] The presence of nicotinamide-deamidating enzyme in various germinating pulses like green gram (*Phaseolus radiatus*), black gram (*Phaseolus mungo*), Bengal gram (*Cicer arietinum*), horse gram (*Dolichos bifuiorus*), red gram (*Cajanus indicus*), French bean (*Phaseolus vulgaris*) and Indian corn (*Zea mays*) and the intracelluar locale of the enzyme in the green gram seedlings are reported in this note.

Germination of the various pulses was carried out, inside a sterile petri dish, over a filter circle, in diffused daylight in a sterile chamber at room-temperature. Homogenates of tissues, namely, the cotyledons, the epicotyl and the hypocotyl were prepared in the chilled mortar and suspended in 2·5% solution of sodium chloride. The complete experimental system contained (in 2 ml.) : 0·5 ml. of 0·4 M Tris (hydroxymethyl amino-methane) buffer at pH 7·0 : 0·5 ml. of nicotinamide solution (4 μ moles) and 1 ml. of the enzyme preparation. In the blank 0·5 ml. of water replaced the nicotinamide solution. Incubation was at 37° C. for 2 hours at the end of which the free nicotinic acid released was determined microbiologically using *Leuconostoc mesenteroids 9135*, which responds specifically to free nicotinic acid.[7]

The distribution of this enzyme in various pulses was first studied. It was found that the tissues of all pulses tested are able to deamidate nicotinamide *in vitro*, the activity decreasing in the order : green gram, black gram, Bengal gram, Indian corn, red gram, French bean and horse gram. Since the tissues of the green gram seedlings possess a high nicotinamide deamidase activity, the activity of the enzyme at various periods of germination was tried and it was found that the deamidase activity of green gram increases during germination, the maximum being reached in 48 hours, beyond which no enhancement in the activity is observed. Moreover, the cotyledons exhibit more activity than the hypocotyl and epicotyl.

Since the green gram seedlings contained maximum enzyme activity the intracellular locale of the enzyme was investigated. The homogenate of the germinated seedlings was prepared in ice-cold sodium chloride (2·5%) solution, using Teflon-pestle homogeniser assembly at 0° C. The fractionation of the homogenate into particulate components and the soluble supernatant was carried out according to the method of Schneider,[8] on an International refrigerated centrifuge (Model PR-2) and the fractions were then assayed for enzyme activity. From the results presented in Table I, it is obvious that

TABLE I

Distribution of nicotinamide deamidase activity in sub-cellular components of green gram seedlings

[Incubation system : 0·5 ml. of 0·4 M Tris (hydroxymethyl amino-methane) buffer pH 7·0, 0·5 ml. of nicotinamide (4 μ moles) and 1 ml. of cell fraction. Incubation at 37° C. for 2 hours and the enzymes activity determined as described earlier.]

Fraction	Nicotinic acid released by 1 ml. of cell fraction (μ gm.)	Per cent total activity	Nitrogen* in 1 ml. of cell fraction (mg.)	Nicotinic acid released/m. of nitrogen (μ gm.)
Unfractionated homogenate	200	100	1·85	108·1
Fraction I (particulate materials corresponding to nuclei, mitochondria and microsomes obtained after centrifugation at 25,000 g.)	20	10	..	..
Fraction II Supernatant	180	90	0·75	240

* Nitrogen present in enzyme preparation and insoluble in trichloro acetic acid, determined by nessleriza tion of a sulphuric acid hydrogen peroxide digest.

the nicotinamide deamidase activity is localised almost exclusively in the soluble portion of the cytoplasm and the small amount of activity, associated with the fraction sedimenting at 25,000 g., is probably due to the presence therein of a small percentage of intact cells.

The presence of the enzyme nicotinamide deamidase in various germinating pulses points out that the plant system resembles the organisms, *Neurospora crassa*, the rice moth larva (*Corcyra cephalonica* St.) and the green pea in being apparently incapable of methylating nicotinamide,[4-6] and it can be suggested that methylation and deamidation of nicotinamide are probably alternative pathways in the metabolism of the vitamin.

Univ. Biochem. Lab. M. A. MUKUNDAN.
Madras-25 (India), T. K. SUNDARAM.
August 1, 1961. E. R. B. SHANMUGASUNDARAM.

1. Hughes, D. E. and Williamson, D. H., *Biochem J.*, 1953, **55**, 851.
2. Oka, Y., *J. Biochem. (Japan)*, 1954, **41**, 89.
3. Halpern, Y. S. and Grossoweiz, N., *Biochem. J.*, 1957, **65**, 716.
4. Sundaram, T. K., Rajagopalan, K. V. and Sarma, P. S., *Ibid.*, 1958, **70**, 196.
5. —, — and —, *Ibid.*, 1960, **74**, 355.
6. Joshi, J. G. and Handler, P., *J. Biol. Chem.*, 1960, **235**, 2981.
7. Johnson, B. C., *Ibid.*, 1945, **159**, 227.
8. Schneider, W. C., *Ibid.*, 1948, **176**, 259.

AMINO-ACID DEFICIENCY OF THE PROTEINS OF LUCERNE LEAF

THE leaves of the lucerne (*Medicago sativa* Linn.) have been shown to have striking supplementary relation to the South Indian rice diet.[1,2] Further, the proteins of lucerne leaf have definite supplementary relation to rice proteins.[3] This appears to be important in view of the fact that Phansalkar *et al.*[4] did not find significant supplementary relation between rice proteins and four other leaf proteins.

The limiting amino-acid of lucerne-leaf proteins is not clearly established. According to the chemical score method of Block and Mitchell,[5] lucerne-leaf proteins are most deficient in isoleucine. Biologically, lucerne proteins have been shown to be effectively supplemented with cystine or methionine.[6-9] Block and Mitchell[5] have suggested that this discrepancy may be due to faulty analysis of isoleucine or due to the presence of stems used in the samples tested biologically.

The effect of adding 0·15% isoleucine on the biological value of lucerne-leaf proteins was therefore studied on adult male rats by the Thomas-Mitchell balance sheet method. Dehydrated lucerne-leaf flour was used as such without attempting to extract the protein. The test diets contained 10% crude protein. In the first period, half the animals received isoleucine supplement and the other half did not. This arrangement was reversed in the second period. The rest of the technique followed was the same as that described by Swaminathan.[10]

The biological values obtained for lucerne proteins with and without isoleucine supplementation were 60·8 + 1·81 and 59·8 + 1·89 respectively. It would be seen therefore that isoleucine supplementation did not increase the biological value of lucerne proteins. Isoleucine is not therefore the limiting amino-acid of lucerne proteins.

G.S.V.M. Medical College, Kanpur, *July* 7, 1961. B. K. SUR. P. P. SINGH.

1. Subrahmanyan, V. and Sur, B. K., *Ind. J. Med. Res.* 1949, **37**, 319.
2. Sur, B. K. and Subrahmanyan, V., *Curr. Sci.*, 1954, **23**, 188.
3. Sur, K., *Brit. J. Nutr.*, 1961 (in press).
4. Phansalkar, S. V., Ramachandran, M. and Patwardhan, V. N., *Ind. J. Med. Res.*, 1957, **45**, 611.
5. Block, R. J. and Mitchell, H. H., *Nutr. Abst. & Rev.*, 1946, **16**, 249.
6. Kellermann, J. H., *Onderstepoort, J. Vet. Sci.*, 1935, **4**, 437.
7. Smuts, D. B. and Marais, J. S. C., *Ibid.*, 1938, **11**, 399.
8. Marais, J. S. C. and Smuts, D. B., *Ibid.*, 1939, **12**, 369.
9. — and —, *Ibid.*, 1940, **15**, 225.
10. Swaminathan, M., *Ind. J. Med. Res.*, 1937, **24**, 767.

ONE-WAY CROSS-RESISTANCE OF STREPTOMYCIN AND KANAMYCIN

KUNIN AND FINLAND[1] observed little or no cross-resistance between streptomycin and kanamycin working with 210 strains of *Staphylococcus aureus* at Boston City Hospital. The present author, working on the same line, came across one mutated strain of *Staph. aureus* which showed a one-way cross-resistance between streptomycin and kanamycin. In general, it was observed that *Staph. aureus* developed resistance to streptomycin more easily than to kanamycin.

The particular mutated resistant strain was encountered during elaborate studies on staphylococcal resistance to drugs. Apart from other morphological and cultural characteristics of this strain which were similar to the parent, it produced a dark diffusible pigment of about 1 cm. in dia. in nutrient agar within 18 hours. The pigmented zone was very unstable and was lost in the next 48 hours.

The *in vitro* studies of a one-way cross-resistance of this strain was conducted with both streptomycin and kanamycin resistant forms (designated as SR 200, SR 400, SR 600 for streptomycin and KR 20, KR 50, KR 100 for kanamycin resistance at their respective numerative levels in μg./ml.) developed from the mutated parent by serial dilution transfers with higher amounts of antibiotic in nutrient broth at pH 7·4. Preliminary observations are presented in Table I.

TABLE I

Growth inhibitions of sensitive and resistant strains of mutated Staph. aureus *by streptomycin and kanamycin*

	Strains	Antibiotic treated	Conc. of antibiotic (μg./ml.)	Opt. density after 36 hrs.	Zone dia. in mm.
1	*S. aureus* mutated parent	Streptomycin	50	·164	>25
2	,,	Kanamycin	50	0	18·5
3	SR 200	,,	50	0	18·5
4	SR 400	,,	50	0	18·5
5	SR 600	,,	50	0	18·5
6	KR 20	Streptomycin	50	0	15·3
7	KR 50	,,	50	·028	14·6
8	KR 100	,,	50	·062	12·8

It was observed that strains resistant to streptomycin was killed by kanamycin, while those resistant to kanamycin showed partial resistance to streptomycin also. The lethality study of kanamycin resistant forms (Fig. 1) revealed that they were partially cross-resistant to streptomycin.

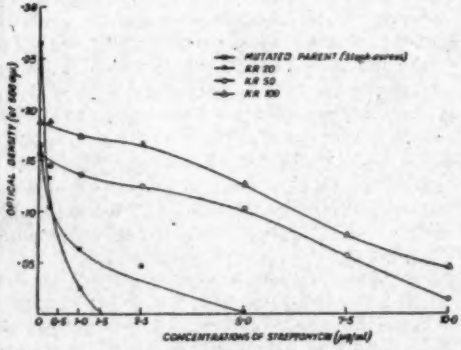


FIG. 1. Growth inhibitions of kanamycin resistant strains of *Staphylococcus aureus* by streptomycin.

Systematic studies on cross-resistance are both of theoretical and practical significance. Bacteria made resistant to a drug developed simultaneously new properties, including sensitivity to other chemotherapeutic agents.[2] It is rather early to postulate a theory interpreting this one-way cross-resistance, unless the mode of actions of these drugs are clearly explained.

Kanamycin (KANTREX) was kindly supplied by Bristol Laboratories, Syracuse, N.Y.

Department of Microbiology, P. M. NAHA.*
Bose Institute,
Calcutta-9 (India), *July* 26, 1961.

* Present Address: Central Rice Research Institute, Cuttack, Orissa, India.

1. Kunin, C. M. and Finland, M., *Ann. N.Y. Acad. Sci.*, 1958, **76**, 42.
2. Szybalski, W. and Bryson, V., *J. Bact.*, 1952, **64**, 489.

DERMATOGLYPHIC STUDY OF TRIBES AND CASTES OF NILGIRI HILLS (MADRAS STATE)

THE dermatoglyphic data from the ten endogamous groups of Nilgiri Hills (Madras) were collected during the months of April to September, 1960, from the three taluqs, namely, Ootacamund, Gudalur and Coonoor and was later analysed by us.* The investigation was conducted in course of an anthropological survey among the tribes of South India on behalf of the Anthropological Survey of India.

TABLE I

Percentage frequency of different fingertip patterns

Groups	Sex	No.	Whorls	Loop Radial	Loop Ulnar	Total Loops	Arch
Paniya ..	M	178	60·67	1·59	36·16	37·75	1·59
do. ..	F	112	53·57	1·61	43·84	45·45	0·98
M. Kurumba ..	M	134	52·83	2·24	44·77	47·01	0·15
do. ..	F	154	45·33	1·95	51·63	53·64	1·04
V. Kurumba ..	M	142	36·84	2·98	57·93	60·91	2·25
do. ..	F	117	26·41	2·39	60·08	62·47	1·11
J. Kurumba ..	M	100	41·60	3·00	55·40	58·40	..
do. ..	F	100	27·00	4·80	66·00	70·80	2·20
Toda ..	M	100	44·60	3·40	49·00	52·40	3·00
do. ..	F	110	48·73	2·18	43·27	45·45	5·82
Kota ..	M	124	42·90	2·10	52·90	55·00	2·10
do. ..	F	100	41·20	1·60	53·00	54·60	4·20
Irula ..	M	170	43·29	3·41	52·00	55·41	1·29
do. ..	F	112	45·00	2·14	50·25	52·49	2·50
Sholaga ..	M	75	51·33	3·33	43·98	47·31	1·33
do. ..	F	88	61·26	0·91	37·73	38·64	..
Badaga ..	M	165	39·57	3·88	54·91	58·79	1·64
do. ..	F	156	42·95	1·67	53·59	55·26	1·79
Moplah ..	M	107	48·41	2·80	46·91	50·71	1·87
do. ..	F	100	44·40	2·80	52·80	55·10	0·50

* The Toda and Kota data were collected by the senior author jointly with Sri. S. K. Basu, while the rest eight groups with Sri. D. B. Sastry.

The data comprise 2,404 individuals (Males—1,255 ; Females—1,149).

The percentile frequency of the different fingertip patterns and the three important main line formulæ on the palms are given in Tables I and II respectively.

TABLE II

Percentile frequency of three important main line formulæ

Groups	Sex	11-9-7	9-7-5	7-5-5
Paniya ..	M	39·13	17·03	22·46
do. ..	F	37·94	17·39	25·94
M. Kurumba ..	M	36·03	18·38	28·67
do. ..	F	25·32	18·83	30·52
V. Kurumba ..	M	33·09	19·36	15·84
do. ..	F	35·47	19·23	21·36
J. Kurumba ..	M	31·00	17·00	31·00
do. ..	F	19·00	18·00	37·00
Toda ..	M	68·00	9·00	2·00
do. ..	F	57·27	1·82	1·82
Kota ..	M	54·86	9·67	5·64
do. ..	F	65·00	4·00	3·00
Irula ..	M	34·11	14·02	24·76
do. ..	F	34·82	16·96	25·94
Sholaga ..	M	30·00	20·00	23·33
do ..	F	22·91	25·00	33·33
Badaga ..	M	30·30	15·15	24·24
do. ..	F	30·43	16·40	29·89
Moplah ..	M	37·60	14·46	29·25
do. ..	F	32·71	14·95	26·17

Details of further analysis will be discussed elsewhere.

Anthropological Survey of India, Calcutta, *July* 17, 1961.

M. R. CHAKRAVARTTI.
D. P. MUKHERJEE.

THE MARINE WOOD-BORER, *XYLOPHAGA* FROM BAY OF BENGAL

RECENT studies on the wood-boring organisms in Indian waters have revealed the existence of several species of *Teredo* and *Bankia*,[1] two species of *Matesia*,[2] two species and a variety of *Sphæroma*[3] and seven species of *Limnoria*.[4] There is, however, no record of *Xylophaga* from this locality. Concerning these pholads Turner[5] states that "The genus *Xylophaga* seems to be largely pelagic, occurring mainly in floating and water-logged wood. The genus is worldwide in distribution, but does not occur in sufficient numbers to be of any real economic importance". It was probably because of their habitat that the animals have so far escaped the attention of workers from this country.

During April 1960 we collected a good number of shells of *Xylophaga* from a log of *Tamarix* sp. which was trapped in a trawl-net operating at a depth of 20 fathoms off Puri, Orissa. The wood was fairly heavily infested by this pholad as well as by *Teredo* (*Zopoteredo*) *trulliformis* Miller, *Sphæroma terebrans* Bate, *S. annandalei* Stebbing and *S.a.* var. *travancorensis* Pillai.

The shells collected agree very closely with the general characters of the genus. The shell is small, globose, teredo-like in appearance, beaked and widely gaping anteriorly and broadly rounded and closed posteriorly. Beaks truncated at nearly right angles to the anterior margin, extend to more than half the distance to the ventral margin and sculptured with finely denticulated ridges. Ridges on the anterior part of the disc more closely set than on the beak. Umbonal ventral sulcus moderately impressed and bordered by a keel. Umbones prominent and placed near the anterior one-third of the shell. Umbonal reflections narrow, partly covering and appressed to the umbones and free anteriorly. Dorsal plates consist of a divided mesoplax, ear-shaped in appearance and partly covering the umbones. Interior of the shell white and glazed. Posterior adductor muscle scar elongate oval and bounded on its posterior side by a shelf. A ventral adductor muscle scar is apparent. Umbonal ventral sulcus expressed internally as a narrow but prominent and transversely grooved ridge with a small condyle at the ventral margin. Apophysis absent. A chondrophore is present on the left valve. The biggest shell measures 7·8 mm. in length and 7·0 mm. in height.

The soft parts have all disintegrated as the wood was outside sea-water for five days after collection.

The present form resembles *X. mexicana* Dall in the nature of the beak, the muscle scars, the broadly reflected dorsal margin and in the nature of the umbonal ventral sulcus which is narrow and bordered by a keel posteriorly and expressed internally as a pronounced, transversely grooved ridge. Unfortunately the dorsal plates of the above form are not known. According to Turner[5] *X. mexicana* shares many characters in common with *X. globosa* Sowerby and she opines that they may actually turn out to be the same species. The dorsal plates of the shells collected in our sample are identical with those of *X. globosa*. This and the other characters mentioned would prove beyond doubt that *X. globosa* and *X. mexicana* are, at least, most closely related.

According to Gamble[6] *Tamarix* sp. from which the shells have been collected is "chiefly found on the banks of streams and on the low lands near rivers". There is therefore little doubt that the timber under question has been washed down the Mahanadi or the Ganges and that the

attack by *Xylophaga* took place in the near vicinity of the area from which it has been recovered. This is also borne out by the fact that the three sphæromids encountered in the wood are characteristic of the estuaries of the Indian rivers and, though not actually recorded, are certain to be found in the estuarine areas of these two rivers.

The present record is interesting since it brings to light the existence of yet another borer *Xylophaga* sp. in Indian waters and from what can be judged from the magnitude of destruction in the sample the animals may prove to be economically important. Whether *Xylophaga* is attacking only flotsam or is also infesting the mangroves and other wooden structures could be ascertained only after a visit to that locality.

We are thankful to the personnel of the C.M.F.R.I., Waltair Unit, for placing the infested log of wood at our disposal and to Dr. A. Purushotham, Officer-in-Charge, W.P. Branch, Forest Research Institute, Dehra Dun, for kindly arranging for the identification of the timber by the Wood-Anatomy Branch of that Institute.

This work has been carried out with the funds provided by the Forest Research Institute, Dehra Dun, obtained from various sources for the execution of the Scheme on "Protection of Timber against Marine Organisms' Attack".

Dept. of Zoology, P. N. GANAPATI.
Andhra University, M. V. LAKSHMANA RAO.
Waltair, *July* 29, 1961.

1. Becker. G., *F.A.O. Expert's Report No.* 795, Rome, 1958.
2. Daniel, A. and Srinivasan, V. V., "Occurrence of two wood-boring pholads at Madras," *Curr. Sci.*, 1956, **25**, 259.
3. Krishna Pillai, N., "Wood-boring crustacea of Travancore. I. *Sphæromidæ*," *Bull. Centr. Res. Inst.*, Uni., Travancore, Trivandrum, 1955, **4 C**, 127.
4. Ganapati, P. N. and Lakshmana Rao, M. V., "On some wood-boring crustacea from Andamans," *Curr. Sci.*, 1960, **29**, 275.
5. Turner, R. D., "The family Pholadidæ. II. Martesinæ, Jouannetiinæ and Xylophaginæ," *Johnsonia*, 1955, **3** (34), 65.
6. *Gamble, J. S., *A Manual of Indian Timbers*, London, 1922.

* Not referred to in original.

A NOTE ON THE FEEDING MECHANISM OF *X. CHEOPIS*

GORDON AND LUMSDEN,[1] Gordon and Crewe,[2] Griffith and Gordon,[3] Lavoipierre, Dickerson and Gordon[4] have been working on the feeding mechanism of mosquitoes, tsetse flies, sandflies and bugs. The anatomy of the head and the proventriculus in fleas has been worked out in recent times by the Plague Advisory Committee,[5] Bacot and Martin,[6] Snodgrass,[7] Karandikar and Munshi,[8] Wenk,[9] and Deoras and Joshee,[10] but there has been no work done on the feeding mechanism in fleas, particularly to know whether it is pool feeding or capillary feeding. The present studies were therefore made to elucidate some aspects of the feeding behaviour of the proboscis of *X. cheopis*, a major vector of Plague in India.

Starved flea was allowed to feed on the ear of a mouse anæsthetised by phenobarbitol sodium. The flea was held in a tube on the ear. Drops of chloroform were released which created an anæsthetic effect on the flea. Partly anæsthetised flea lay limp with its proboscis still stuck in the ear tissue. A portion of the ear with the mouth parts of the flea was cut and fixed in carnoy. It was later processed to get serial sections. Similar preparations were made by cutting the flea behind the head with a sharp blade while it was still feeding on the ear. The results of these studies are given below.

The flea was seen many a time to pierce the skin but did not feed. In such cases it would either completely withdraw the stylets and try a fresh puncture or pull off the stylets to some distance and again thrust the organs to find a proper source of blood. The flea could change the position of stylets inside the tissue even though it kept to the original puncture. Once the puncture was made the stylets penetrated the skin and the labial palps remained bent on the outside. Maxillary lobes also touched the skin of the host. In this position the abdomen of the flea was lifted up.

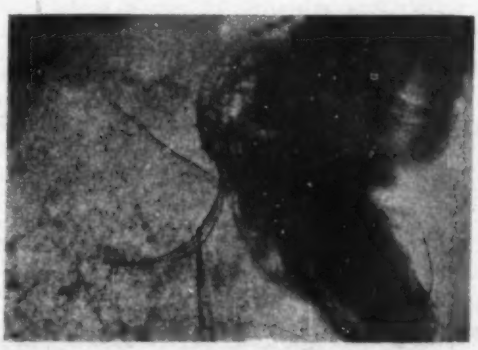


FIG. 1. Photograph of the head of *X. cheopis* showing stylets in the skin of the mice ear (whole mount preparation).

The feeding of the flea is not interrupted by a mechanical stimulus, unless it has completely fed. The flea seems to be fed even by piercing the stylets half-way in the skin of the host.

Evidence of gross movements of the stylets inside the host tissue were seen in cleared whole mounts. They showed that the stylets may not be forced in perpendicularly but may be bent at any angle even parallel to the skin surface. This showed the flexible nature of the stylets. It was further confirmed in the histological sections of such preparations. These sections showed a longitudinal axis of the fascicle which was confirmed by the observations on the transverse sections of the fascicle in the series. This demonstrates the bending of the fascicle and its flexibility. Such behaviour also tends to show that the flea need not penetrate the mouth parts deep into the skin, but can take the feed only from the superficial layers.

Apart from these bending movements due to the flexible nature of the stylets, it was observed in one case that the stylets turned their axis through an angle of 90°. The anterior face of the stylets was turned to the lateral side. The serial sections of the tissue with the inserted fascicle showed this turning, suggesting that the stylets may also have revolving or screwing type of movement.

The examination of the skin with the fascicle embedded inside has shown that when the fascicle has pierced a capillary it revealed blood in the channel of the fascicle. Blood was not seen inside the food channel when the fascicle was noticed elsewhere in the tissue. This indicated that probably the way in which the flea normally feeds was by "the capillary method".

While studying the method of feeding of *Phlebotomus argentipes* in relation to the transmission of Kala azar, Shortt and Swaminath[11] found that the *L. tropica* parasites are introduced by the sand-fly into the tissue and also into the general circulation. Parasites introduced into the general circulation were destroyed, while those at the site of the bite multiplied.

It can thus be surmised that the flexibility of the stylets in the flea *X. cheopis* makes it move in various directions in the tissue in search of a blood capillary for feeding purposes. A contaminated proboscis with *P. pestis* will thus be able to disperse the bacilli in a wider zone. The regurgitation of the block by such fleas directly into the capillary may give a double dose of infection, i.e., locally and in the circulation. Actual transmission and bacteriological examination may confirm this view.

The details of these studies are being published elsewhere.

We are extremely thankful to Dr. H. I. Jhala, Director, Haffkine Institute, for encouraging these studies and to Mr. N. E. Vad for his valuable help from time to time.

Haffkine Institute, Bombay-12, *August* 16, 1961.

P. J. Deoras.
A. K. Joshee.

1. Gordon, R. M. and Lumsden, W. H. R., *Ann. Trop. Med. Parasitol.*, 1939, **33**, 259.
2. — and Crewe, W., *Ibid.*, 1948, **42**, 334.
3. Griffiths, R. B. and Gordon, R. M., *Ibid.*, 1952, **46**, 311.
4. Lavoipierre, M. M. J., Dickerson, G. and Gordon, R. M., *Ibid.*, 1959, **53**, 235.
5. Plague Research Commission, *J. Hyg.*, Camb., 1906, **6**, 486.
6. Bacot, A. W. and Martin, C. J., *Ibid.*, 1914, **13**, 423.
7. Snodgrass, R. E., *Smith. Misc. Collections*, 1946, **104**, (18), 1.
8. Karandikar, K. R. and Munshi, D. M., *Jour. Univ. Bombay*, 1949, **18**, 60.
9. Wenk, P., *Zool. Jahrb.*, 1953, **73** 103.
10. Deoras, P. J. and Joshee, A. K., *Indian Jour Med. Res.*, 1959, **47**, 261.
11. Shortt, H. E. and Swaminath, C. S., *Ibid.*, 1926, **15**, 827.

VIABILITY OF STORED SEED WHEAT SAFEGUARDED BY SEED DRESSING

Imported wheat grains meant for sowing are usually given a seed-dressing treatment with mercury compounds to guard against the introduction of seed-borne diseases like Bunt. Indeed such a treatment is imperative if the importing country is known to be free from such diseases. But at the present moment there seems to be no information on record as to how long such treated grains could be kept without affecting their viability under Indian conditions. Lack of knowledge on this point was, of late, found to be a great handicap in Bihar, where in recent years wheat cultivation had received a serious set-back due to abnormal floods or drought at the normal sowing period.

This often necessitated a resowing of entire areas, for which tons of seed wheat had to be railed from the Punjab. As, however, the Punjab and Western Uttar Pradesh were known to be subject to various seed-borne diseases, —not so far recorded from Bihar,—all imported grains had to receive a seed-dressing. Owing partly to the higher price of such seed due to the additional cost of transport and seed-dressing, and partly also due to delays in delivery—passing beyond the normal sowing period, a good proportion of the imported stock was left over, which could not be used for

consumption either by man or cattle, owing to the contamination of mercury compounds.

In these circumstances, in the absence of data on the limit of viability of treated seeds, the following experiments were started to get reliable data in the matter.

The usual method of seed-dressing is by the application to seed-grains of AGROSAN-GN, a ready-made mercury compound, marketed in India by the Imperial Chemical Industries Ltd., at the rate of 4 oz. (0·117 Kg.) to a maund (37 Kilos) of grain.

Experiments were devised using healthy wheat seed of NP 52 variety stored in small jute bags of the type generally used by Indian stockists, with a capacity of holding 10 seers (9 kilos) of grain, as units for observation. The chemical was applied to seed by using a seed-dressing drum and the treated seed was kept in a set of 4 small bags, which were duly labelled and closed by tying them up with string. As control, another set of 4 bags of untreated seed was kept under identical conditions in the laboratory. Seeds showing less than 90% germination were not used for the experiment.

During the first year, fortnightly examinations were made by taking 25 grains at random from each bag for testing their germination capacity, and the result recorded. During the second year, a fresh set of experiments was started, but it was felt that a three-monthly test would equally serve the purpose of the experiments. The results of the examinations made are given in Table I.

TABLE I

Showing the comparative results of germination tests carried out on treated and untreated seed during two years

Period	Year 1957–58		Year 1958–59	
	Treated %	Untreated %	Treated %	Untreated %
1 Oct.–Dec. ..	100	99·5	99·5	99·5
2 Jan.–March ..	98·3	97·3	98·5	97
3 April–June ..	96·3	98·7	97	96
4 July–Sept. ..	92·6	80·8	..	..
As examined on 25 Oct. 1958	88·5	33·5	As examined on 20 Oct. 1959	
			94·5	52·5

It may be seen from the above data that in the case of the untreated seed, there had been a sharp fall in germination capacity at the end of the monsoon period, whereas there was very little in the case of the treated grains. These trials have clearly demonstrated that treated seed can be kept with impunity in store for a year without loss of viability, which was all that these experiments were designed to show. It is regretted that the scope of these studies could not be extended further.

This work was taken up at the personal suggestion of the Hon'ble Minister of Agriculture, Shri B. C. Patel, to whom the writer is grateful. He also wishes to record his thankfulness to Shri Leslie Jones for assistance given in the germination counts at the Agricultural Research Institute, Patna.

Kanke, Ranchi, A. C. SEN.*
August, 1961.

* Formerly Director, Agricultural Research Institute, Patna (now at Agricultural College, Kanke, Ranchi, Bihar).

A LOCALISED CHLOROPHYLL DEFICIENCY ASSOCIATED WITH MALE STERILITY IN *NICOTIANA TABACUM* L.

SPONTANEOUS occurrence of male sterility controlled by single or duplicate factors is known only in a few cases in *Nicotiana tabacum* (Raeber and Bolton, 1955, and Bhat and Krishnamoorthi, 1956). Other teratological modifications of the stamens and consequent male sterility controlled by a single gene are also reported in X-ray populations of the same species (Goodspeed, 1930).

During the screening of the irradiated material of flue-cured varieties of *Nicotiana tabacum* for viable mutations after seed treatment with thermal neutrons. (flux 1×10^{12} to 5×10^{13} N.sec.cm.^{2}), male sterile plants appeared in the n_2 generation in five different lines.

Three varieties, *viz.*, Hicks, Delcrest and Chatham, were irradiated at the levels mentioned above. But male sterile plants appeared only in Hicks and at the dose 1×10^{12} N(cm.)^2. Several plants had been selfed in the n_1 generation both in the control and irradiated populations. Of them, 10 lines were raised in each category. Only 5 of the 10 lines in the irradiated population seggregated for male sterility.

Two categories of male steriles were found. In both cases the anthers were rudimentary.

In one there was development of appendages with no sporogenous tissue; in this case seed set could be obtained by pollinating with normals indicating that the female gametes were functioning normally.

In the second category, appendages were absent, the stigma was yellow and the style was very short, 5–6 mm., compared to over 40 mm. in the normal plants. These plants were also characterised by condensed panicles, clustering of flowers and cleistogamy (Figs. 1 and 2 *c*, *d*). The corolla was whitish anfi .the

Among the five lines three seggregated only for male sterility, one for 'yellow stigma' only and one for both 'male sterility' and 'yellow stigma'. In the 'yellow stigma' seggregants none were present with appendages on the anthers similar to those found in the first category of male sterility. The data suggest that

FIG. 1. Panicle of the ' yellow stigma ' mutant showing crowding and cleistogamy of flowers.

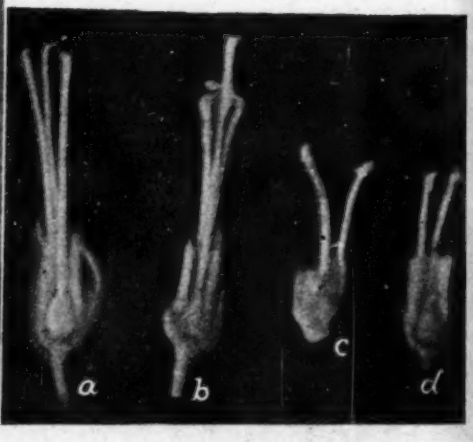


FIG. 2. Flowers of *a*, normal; *b*, males sterile; *c* and *d*, yellow stigma mutant. Note the dwarf style in *d*.

younger leaves below the peduncle turned yellowish-green with the onset of reproduction, while the lower leaves remained normal green. The stamens were reduced in size and obliterated. Pollen was absent in all cases except in one of the flowers which had nearly 10% stainable pollen. Pollination with abundant pollen from the normal sibs failed to give any seed set indicating female sterility also.

The n_1 plants from whose progenies these two types of male steriles were obtained were phenotypically normal and the F_1 between the first category of male sterile mutant and the normal was completely fertile. This character can therefore be considered to be recessive to normal. The distribution of the different categories of mutants in the n_1 and n_2 generations is given in Tables I and II. The two classes of mutants are called "male sterile" and "yellow stigma" respectively for brevity.

the first case of male sterility is due to duplicate recessive factors. Line-1 gave simplex seggregation suggesting that it is homozygous for one of the recessive genes. The 'yellow stigma' character also appears to be due to duplicate recessive factors. To ascertain whether the male sterility in 'yellow stigma' plants is due to pleiotropic effect of the genes for chlorophyll deficiency or due to close linkage with genes for male sterility, test for linkage was carried out by Fisher's scoring method. The test confirmed that linkage was not involved. Therefore the male sterility in the 'yellow stigma' is due to the pleiotropic effect of the genes for chlorophyll deficiency and appears to be distinctly different from the male sterility with the anther appendages encountered in the same population. These two mutants appeared only in Hicks but not in the other varieties (Table II). Such a specific response by a variety to a certain dose

TABLE I

Distribution of mutant categories in the n_1 and n_2 generations

Generation	Variety	Total plants studied	Chlorophyll mutants (seedlings)		Leaf modifications No. of plants different in leaf characters from normal	Floral teratology			Sterile mutants		
			Normal	Albina		Split flr.	Calycina	Cleistogamous	Pollen abortion over 30%	Male sterile anthers	Complete sterility
n_1	Hicks	480	480	..	14	1	1	1	136	1	..
	Delcrest	420	420	..	6	..	..	..	75	..	..
	Chatham	270	270	..	1	..	..	..	69	..	..
n_2	Hicks	800	540 (separate scoring)	168	2	..	..	..	20	185 (Normal) 28 Male sterile	101 (Normal) 8 Yellow stigma
	Delcrest	900	..	..	1	..	..	..	16	..	..
	Chatham	900	..	..	..	..	..	..	..	..	..

TABLE II

Distribution of 'male sterile' and 'yellow stigma' mutants in the n_2 generation

Sl. No.	Lines	Total No. of plants	Normal	'Male sterile'	'Yellow stigma'	X^2
1	7-44 (3 : 1)	55	40	15	..	0·1514
2	23- 8 (15 : 1)	48	43	5	..	0·893
3	20-32 (15 : 1)	54	51	3	..	0·0743
4	23-16 (15 : 1)	56	50	..	6	1·167
5	23-42	58	51	5	2	2·157

indicates that the residual genotype has considerable influence on the mutability of the concerned loci. It is interesting that both these cases are due to duplicate factors while in X-rayed population studied by previous workers, male sterility was a simple recessive. The denser ionizing radiation of neutrons is responsible for simultaneously knocking out the two loci concerned and the higher viability of the neutron-treated material compared to X-rayed material has permitted the detection of the mutants which would have been lost due to the drastic side-effects of the X-rays.

Studies are under way to ascertain whether the male sterility genes are iso-allelic with other male sterile lines maintained at this Institute. The genes for yellow stigma were designated as ys_1 and ys_2. These are different from the stigmatoid gene isolated by Goodspeed (1930). The manifold effects associated with the dwarfing of stigma without any reduction in the vegetative plant organs is unique in this case.

Central Tobacco Research Institute, Rajahmundry, *July* 22, 1961.

G. S. MURTY.
K. V. KRISHNAMURTY.
B. R. MURTY.

1. Bhat, N. R. and Krishnamoorthi, T., *Curr. Sci.*, 1956, **25**, 297.
2. Goodspeed, T. H., *Univ. Calif. Pub. Bot.*, 1930, **11**, 285.
3. Raeber, J. G. and Bolton, A., *Nature*, 1955, **176**, 314.

ON THE MORPHOLOGY OF THE POLLEN GRAINS OF THE TWO SPECIES OF *CUCURBITA* L.

IN an intensive study of the pollen morphology of *Cucurbita moschata* and *C. pepo* the following pollen characters were noted :—

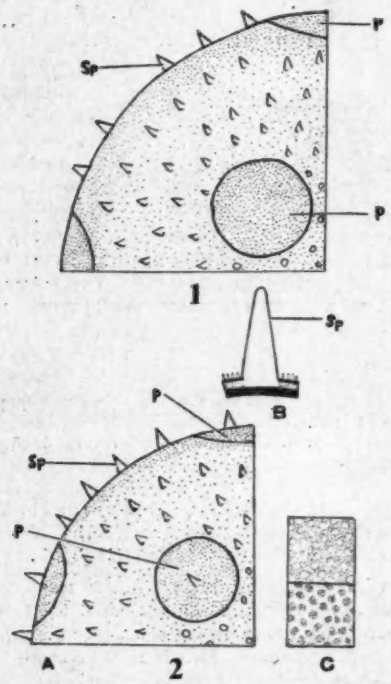
C. moschata Duch. ex. POIR (Fig. 1)—Panporate, spheroidal (average diameter 107 μ, exclusive of the excrescences). Pores circular (diameter 32 μ). Interporal distance 49 μ. Exine 1·4 μ thick (exclusive of excrescences). Ectine thicker than endine, spinate in a majority of grains. Interporal area provided with minute projections (LO). Variations in different morphological structures have been studied as follows :

(i) Size varies from 85–193 μ. Grains having a size of 95 μ form 1%, 193 μ form the maximum of 13% and the "giant grains" having a size of 304 μ form 1%. Double grains[1] measure 231–63 μ. Average size

of unacetolysed grains is 126 μ (range; 91–210 μ).

(ii) *Apertures*—Rarely 3-Zonicolporate, 3-Syncolpate or 3-Zoniporate, along the panporate grains.

(iii) Excrescences—Various types of excrescences forming different percentages are as follows: (*a*) spinate (with pointed ends; 40%); (*b*) clavate (17%); (*c*) spinate (with blunt ends 15%); (*d*) verrucate (14%); (*e*) baculate (8%); (*f*) clavate + spinate (spines with blunt ends 6%). Middle regions in the double grains are unornamented.[2,3]



FIGS. 1–2. Fig. 1. Palynogram of *C. moschata*; General surface of the quarter of a grain shown. Fig. 2. Palynogram of *C. pepo*. *A*—General surface (quarter of a grain shown). *B*—Strata. *C*—LO pattern of interspinal area. *P* = pore; *Sp* = spine. 1 & 2, × 500; B & C, ×2,000.

C. pepo D.C. (Fig. 2)—Pamporate, spheroidial (diameter 140 μ; range 123–201 μ). Pores circular (diameter 25 μ), tenuimarginate, pore membrane-bearing spines. Interporal distance 53 μ. Exine 1 μ thick, spinate (spine ends acute; 7 μ long; basal diameter 2·8 μ). Interporal distance 14 μ. Interporal area bears profuse, rod-like projections.

The large variations in size and apertural characters noted in the above grains are probably the result of polyploidy and hybridization.[4] Frequency of the morphological features may constitute a varietal character. A fuller paper will be published elsewhere.

I am grateful to Dr. A. R. Rao for suggesting this polynological problem and guiding me, and to Dr. P. K. K. Nair for many valuable suggestions.

Botany Department, Lucknow University, Lucknow, *April* 27, 1961.

MISS PRITI AWASTHI.

1. Sampath, S. and Ramanathan, K., *J. Indian bot. Soc.*, 1951, **37**, 220.
2. Nair, P. K. K., "Pollen grains of Indian plants," *Bull. Nat. Botanic Gardens*, Lucknow, 1961, **1**, 53.
3. Wodehouse, R. P., *Pollen Grains*, McGraw-Hill Book Co., New York, 1935.
4. Nair, P. K. K., *J. Indian bot. Soc.*, 1960, **39**, 373.

A NEW SPECIES OF *ALTERNARIA* FROM BOMBAY-MAHARASHTRA—II

IN the course of his investigation into the fungus genus *Alternaria* in the Bombay-Maharashtra, the writer encountered vines of *Dioscorea alata* L. growing at a local Agriculture Farm, Poona, showing severe and extensive blighting. The necrotic areas invariably yielded a pure culture of an *Alternaria* species. A careful search of the available literature showed that no species of *Alternaria* has been previously reported, on this host. The fungus thus appeared to be new to science and is presented here as new species with Latin diagnosis.

Alternaria dioscoreæ VASANT RAO, SPEC. NOV.

Infectionis maculæ epiphyllæ, dispersæ, irregulariter ovoideæ, fusce brunneæ, 15 × 9 mm. Conidiophori singuli vel fasciculati, emergentes per stomata, epiphylli æque ac hypopylli, erecti, plus minusve curvati, semel vel bis septati, non-constricti, basi bulbosa, apice rotundato, sæpe una cicatrice terminali præsenti, 25·2–92·4 × 4·2–5·2 μ.

Conidia copiosa in planta hospite, breviter catenulata (2-3), alte brunnea, obovata vel obclavata, rotundata ad basim, fastigata ad apicem in rostrum non septatum ornata septis 4-7 transversis, 2-3 longitudinalibus, septis obliquis raris, constricta ad septa, 48·3–79·8 × 12·5–14·5 μ rostro incluso, 35·7 × 13 μ absque rostro.

In foliis et surculis viventibus *Dioscoreæ alatæ* Linn., mense septembri anni 1960, ad Poona, in India; leg Vasant Rao.

Typi harum specierum positi sunt in Herb. Crypt. Indiæ Orient. ad New Delhi et in Commonw. Mycol. Inst. in Horto Kewensi, in Anglia.

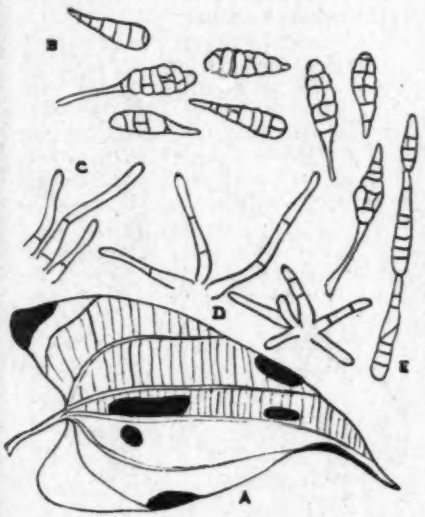


FIG. 1. Alternaria blight of *Dioscorea alata* L. *A*, habit (½ Natural size), *B*. Conidia, *C*. Conidiophores, *D*. Branched conidiophores, *E*. Catenulate formation of conidia, All, × 220.

Alternaria dioscorii SP. NOV. VASANT RAO (FIG. 1)

Infection spots, epiphyllous, scattered irregularly ovoid, and dark-brown in colour, 15 × 9 mm.

Conidiophores, single or in fascicles, emerging through stomata, epi as well as hypophyllous, erect, more or less bent, 1-2 septate, not constricted, bulbous at base and rounded at apex, often with a single terminal scar, 25·2–92·4 × 4·2–5·2 μ. Conidia abundant on host in short chains (2 to 3), deep-brown, obovate to obclavate, rounded at base, tapering towards apex into a non-septate beak, with 4-7 cross septa, 2-3 longitudinal septa, oblique septa rare, constricted at septa, 48·3–79·8 × 12·5–14·5 μ (with beak), 35·7 × 13 μ (without beak).

In living leaves and shoots of *Dioscorea alata* L. September 1960, Poona, India, Collected by Vasant Rao.

The type specimen has been deposited at the Herbaria Cryptogamia Orientalis, New Delhi, India, and Commonwealth Mycological Institute, Kew, England.

Further work on the etiology of this fungus is in progress and will be reported in due course.

The writer is grateful to Prof. M. N. Kamat for his deep interest, encouragement and guidance, to the Director, M.A.C.S., Poona 4, for facilities at the Institute and to Prof. H. Santapau, Chief Botanist, Botanical Survey of India, Calcutta, for Latin rendering of the description of the new species. He is also grateful to I.C.A.R., New Delhi, for the award of a research scholarship.

M.A.C.S., VASANT GURUNATH RAO.
Poona-4, *September* 10, 1961.

STRUCTURE AND ONTOGENY OF EPIDERMAL APPENDAGES ON THE FLORAL ORGANS OF *OCIMUM BASILICUM* L.

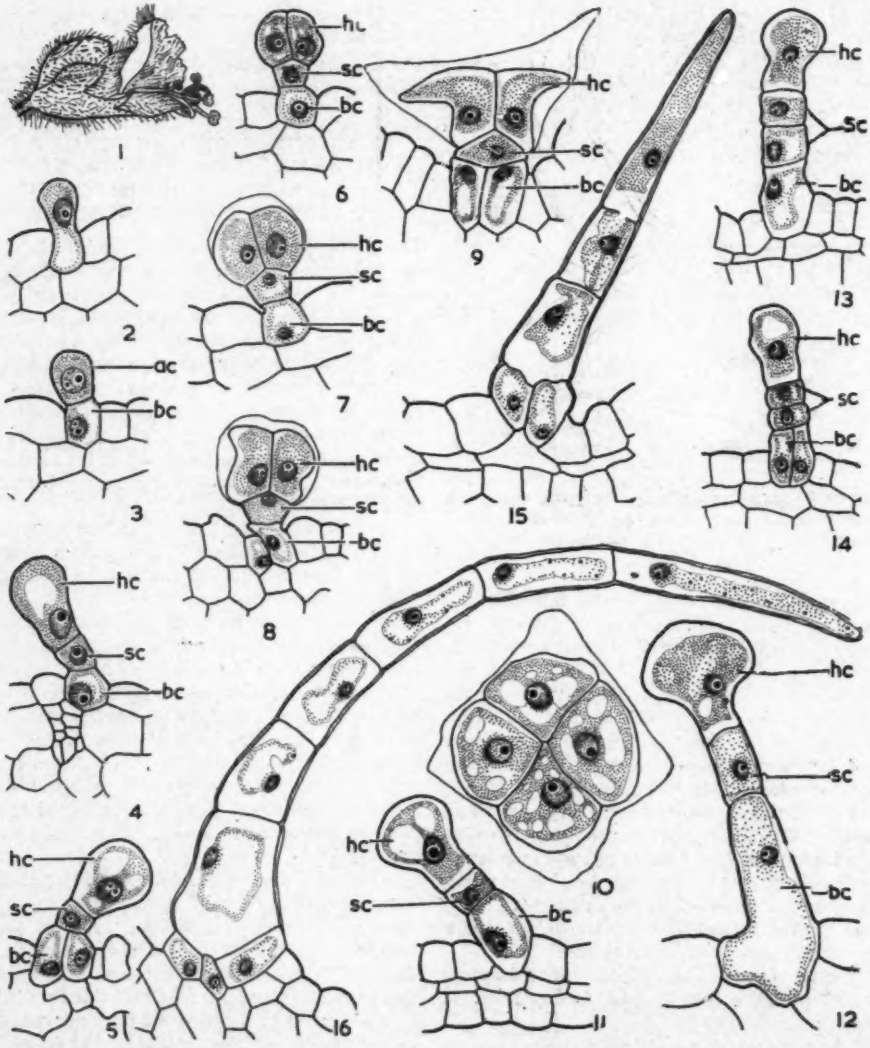
THE taxonomic significance of hairs and glands has been emphasized by several workers from time to time. Bachmann[1] investigated the structure of hairs of 34 families of angiosperms and presented a key for their identification. Cooper[5] studied their structure and development in the Elæagnacæ. Murthy[7] described the glandular hairs in *Orthosiphon stamineous* and recently Carlquist[2–4] gave an account of their development in some members of the Compositæ. However, our knowledge regarding their ontogeny is still meagre.

Various types of hairs and glands occur in the family Labiatæ and serve as valuable characters for the identification of the genera and species. The volatile and ethereal oils which give the plants of this family their characteristic aroma, are secretions of these glands. The present paper deals with the structure and development of the glands and trichomes of *Ocimum basilicum* collected from the Delhi University Botanical Gardens. The buds and flowers were fixed in formalin-acetic-alcohol and usual methods of dehydration, infiltration and embedding were followed. Sections were cut at a thickness of 8-12 microns and stained with safranin and fast green.

Metcalfe and Chalk[6] have classified the glandular hairs of the Labiatæ into five different types. In *Ocimum* only one type of gland is reported by them. On the contrary, I have observed three types of multicellular epidermal hairs on the flowers of *O. basilicum* (Fig. 1). These are: (*a*) multicellular glands with four-celled head; (*b*) multicellular glands with one-celled head (this is the type reported by Metcalfe and Chalk[6]); and (*c*) simple, non-glandular, uniseriate, multicellular hairs.

The hair originates from a single cell of the epidermis. In earlier stages of development,

all the cells of the epidermis look alike. Soon one of them becomes distinguishable from the rest by its larger size, dense cytoplasm and conspicuous nucleus. This cell functions as the hair initial. It becomes papillose and vacuolated (Fig. 2), and divides by a transverse septum resulting in the formation of an apical (*ac*) and a basal cell (*bc*, Fig. 3). The former has denser cytoplasm and a comparatively large nucleus. It divides periclinally to form two cells of which the upper develops into the head of the gland and lower forms its stalk (Fig. 4). This is in



FIGS. 1–16. Glands and trichomes. Fig. 1. Flower bearing glands and trichomes. Fig. 2. Papillate epidermal hair initial. Figs. 3–4. Two- and three-celled stages. Figs. 5–6. Four-celled hairs; in Fig. 5 the basal cell has divided vertically. Figs. 7–9. Hairs with distended cuticle. Fig. 10. T.s. through the head of a glandular hair. Figs. 11–14. Stages in the development of glandular hair with single-celled capitate head. Figs. 15–16. Uniseriate multicellular trichomes.

Fig. 1, × 8; Figs. 2–16, × 970. (*ac*, apical cell; *bc*, basal cell; *hc*, head cell; *sc*, stalk cell).

contrast to Murthy's[7] observations on *Orthosiphon stamineous* where the hair initial divides transversely into a head and a stalk cell. The latter again divides periclinally to form the middle and the basal cells; the middle cell forming the stalk of the gland.

Further development differs in the various types of hairs. In the first or type A, at the three-celled stage, the head cell (*hc*) becomes capitate (Fig. 5) and divides anticlinally to form two cells (Fig. 6). Another division results in the formation of four cells (Fig. 10). The stalk cell (*sc*) remains undivided and pushes into the base of the glandular head whereas the basal cell undergoes a vertical division and becomes two-celled (Fig. 8). Rarely the basal cell may remain undivided. The metabolic by-products secreted by the glands accumulate between the cell-wall of the head and the cuticle which becomes distended at the 2-celled stage of the head (Figs. 7-9). Due to the pressure exerted by these, the cuticle bursts and the secretion escapes into the atmosphere producing the characteristic aroma.

In type B there is slight elongation of all the cells at the three-celled stage. Subsequently the head cell assumes a capitate form (Figs. 11, 12); the stalk cell divides transversely to form two cells (Fig. 13); and the basal cell undergoes a vertical division (Fig. 14). This results in a multicellular gland with one-celled head, two-celled stalk and a uni- or bi-celled base.

In the third type C, soon after the two-celled stage, the upper cell elongates and assumes a tapering appearance. It undergoes several transverse divisions resulting in the formation of a uniseriate six- to eight-celled, heavily cutinized, trichome (Figs. 15, 16). Further divisions in the lower cell form a two- or three-celled base.

It gives me great pleasure to express my gratitude to Dr. R. N. Kapil and Professor P. Maheshwari for their guidance and constant encouragement during the course of this investigation.

Department of Botany, SNEH LATA MATHUR.
University of Delhi,
Delhi-6, *September* 16, 1961.

1. *Bachmann, O., *Flora*, 1886, **69**, 387; 1886, **69**, 403; 1886, **69**, 428.
2. Carlquist, S., *Amer. J. Bot.*, 1958, **45**, 675.
3. —, *Ibid.*, 1959 *a*, **46**, 70
4. —, *Ibid.* 1959 *b*, **46**, 300.
5. Cooper, D. C., *Ibid.*, 1932, **19**, 423.
6. Metcalfe, C. R. and Chalk, L., *Anatomy of Dicotyledons*, Clarendon Press, Oxford, 1950.
7. Murthy, S. N., *Curr. Sci.*, 1941, **10**, 534.

* Not seen in original.

RESPONSE OF HYBRID MAIZE TO ZINC FERTILIZATION

Of all the essential micronutrient elements, maize has the highest requirement for zinc. Very encouraging results have been reported from various parts of the world, regarding the crop responses to zinc fertilization.[1,2,4-6] Light soils particularly, are known to be deficient in zinc. Zinc content of the light alluvial soils of northern India, as judged from the available data, also appears to be low: total zinc content of Panjab soils has been reported to be 55 p.p.m.,[5] while the soils of I.A.R.I. farm have been found to contain only 20 p.p.m.[3]. These figures are evidently far below the average figure of 80 p.p.m. of total zinc reported to be present in the lithosphere.[7]

With the prospects of introduction of hybrid maize for general cultivation in this country in the near future, investigations on the nutrition of hybrid maize have been initiated at the Division of Agronomy, I.A.R.I., New Delhi. The quick growing nature of this crop, the high nutrient uptake in general, and the high zinc requirement in particular, together with the evidence of low content of zinc in the soils of I.A.R.I. farm cited above prompted the initiation of investigations on the zinc fertilization of hybrid maize.

The present investigation was, therefore, planned in *Kharif* 1960 to study the response of hybrid maize variety Texas 26, to the application of zinc and a number of other micronutrients with and without a basal dose of NPK fertilizers. In the same experiment, seed, soil and spray methods of applications were also tried. There were, in all, 24 treatment combinations which were replicated four times in a Randomised Block Design. However, in this brief note, only the treatments relevant to the assessment of the response of Texas 26 to zinc fertilization have been given in column No. 2 of Table I. The standard error and the L.S.D. used to test the significance of differences between these various treatment combinations are the same as obtained from the analysis of the entire experimental data.

RESULTS

The data on the yield of total dry matter and grain yield of hybrid maize, are presented in Table I.

It is evident from the data that responses to micronutrients were obtained only in the presence of NPK. Highly significant increase in dry matter was obtained when zinc was applied to soil in conjunction with NPK as

compared to NPK alone. Soil application of all the essential micronutrients used, did not give any additional increase over the treatment when zinc was used alone. Seed-soaking treatment with zinc and other micronutrients proved to be the best in improving dry matter yield by about 20·2% over NPK.

TABLE I

Effect of zinc fertilization on the total dry matter and grain yield of Texas 26

S. No.	Treatment	Total dry matter yield tons/hect.	Grain yield kg./hect.
1	Control (No NPK) ..	3·775	539·81
2	Zn+other* micronutrients in soil (No NPK)	3·866	458·53
3	Zn+other micronutrients as spray (No NPK)	2·757	282·83
4	Zn+other micronutrients as seed soaking (No NPK)	3·218	353·38
5	NPK (No micronutrients)	6·869	1714·87
6	NPK+Zn in soil	7·968†	2140·47
7	NPK+Zn as spray	5·976	1498·20
8	NPK+Zn+other micronutrients in soil	7·439‡	2257·38‡
9	NPK+Zn+other micronutrients as spray	6·566	1380·48
10	NPK+Zn+other micronutrients as seed soaking	8·260†	2232·91
	S.E.Dm.	±0·253	±272·09
	L.S.D. (P=0·05)	0·500	537·47
	L.S.D. (P=0·01)	0·667	..

Note.—The doses of $ZnSO_4.7H_2O$, used in soil, spray and seedsoaking, were 5·60, 1·121 and 0·026 kg./hectare respectively.

* Other micronutrients applied were Cu, Mn, Fe, B and M_o. Mg a macronutrient was also included.

† Significant at 1%.

‡ Significant at 5%.

Soil application of zinc increased the grain yield. The increase was, however, more when other micronutrients were also applied along with zinc. A significant increase in yield of 32·28% was obtained in the latter case. Seed soaking with zinc and other micronutrients, closely approached the soil application in affecting yield of grain but just missed the level of singnificance as in the case of zinc applied alone in soil. High coefficient of variation (27·25%) obtained in the present case, is largely responsible for this.

Discussion and Conclusions

From the results, cited above, it may be concluded that there was a distinct increase in the total dry matter per acre due to zinc fertilization. Significant increases were likewise obtained in grain yield per acre when zinc was applied in conjunction with other micronutrients. The facts that none of the other micronutrients used in the experiment showed any distinct increase in grain yield individually, and that the increase resulting from zinc application alone missed significance by a very narrow margin, indicate that the major share of the increase in yield due to combination of all micronutrients was due to zinc or at best to its complementary effects with other micronutrients. However, this point needs to be investigated further. The results are evidently of use to all those who are interested in the realisation of maximum yield potential of crops in general and hybrid maize in particular, through balanced nutrition. There are possibilities of increasing the yield of hybrid maize as much as 20 to 30% with zinc fertilization alone as well as with the application of zinc in combination with other micronutrients, over and above the increase obtained with the application of the three major nutrients, NPK.

Division of Agronomy, L. R. Ahuja.
Indian Agricultural O. P. Gautam.
Research Institute,
New Delhi-12, *July* 24, 1961.

1. Barnette, R. M. and Warner, J. D., *Soil. Sci.*, 1935 **39**, 149.
2. *Chilean Nitrate Educational Bureau Bibliography on Minor Elements*, 1948/55.
3. Datta Biswas, N. R. and Dakshnimurti, C., *Ind. Jour. Agro.*, 1958, **3** (1), 48.
4. Grunes, D. L. *et al.*, *Agro. J.*, 1961, **53** (2), 69.
5. Kanwar, J. S. and Randhawa, N. S., *Simla Seminar on "Recent Advances in Agronomy and Soil Science,"* I.C.A.R., 1959.
6. Sadaphal, M. N. and Das, N. B., *Sci. and Cult.*, 1956, **32**, 233.
7. Swaine, D. J., *Commonwealth bur. Soil Science Tech. Commun.*, 48, 1950.

A NOTE ON VEGETATIVE PROPAGATION OF CULTIVATED RICE

In the cultivated varieties of rice so far examined rudimentary buds are present in the axils of leaves especially at the lower nodes. A thin membrane, H-shaped in cross-section is found between the culm and the buds in the leaf axils. The buds as well as the prophyllum situated at different nodes exist in various stages of development, longer at the lowest nodes and shorter at the upper nodes. Minute projections of root primordia are also faintly discernible at times at the base of nodes and with adequate water-supply these root primordia at the lower nodes may grow and develop into roots in some varieties. Such formation of roots at nodes was very marked in PTB. 10 in contrast to other varieties under trial at the Rice Research Station, Moncompu. Normally, the rudimentary

buds in the axils of leaves above the tillering zone do not develop. But in some varieties like floating rices, the axillary buds emerge out and form stems at higher nodes. Tillers may also arise from buds at higher nodes when overaged seedlings are transplanted or when the crop lodges[1] or when the main tiller is damaged either by gall fly, *Pachydiplosis oryzæ* (W.M.), or by stem-borer, *Schœnobius incertellus* Walk.[2]

New shoots emerging from rice stubbles after harvest, ratooning, is a common feature. These ultimately produce short panicles bearing a few spikelets, probably due to the limited availability of nutrients and moisture. Different varieties of rice behave differently in the habit of ratooning and it is the axillary buds developed at the nodes of the stubbles which grow into tillers.[3]

The above observations as well as the ability of stem cutting of a type of perennial floating wild rice, in which the development of buds is much pronounced made the authors feel that it might be possible to propagate some of the cultivated rices by stem cuttings. Observations resulting from a preliminary study are presented below.

Stems showing no decay and with fully matured earheads from two varieties, PTB. 10, a local improved early maturing variety, and P.H. 37, a fully pigmented introduced variety from Bihar, were collected separately. These were cut into pieces with one node in each piece. Cuttings from the portion of the culm above water level were alone taken for planting as it was found that the buds at the lowermost nodes usually exhibited signs of decay. The leaf sheath enclosing the bud was green and hard in some of the cuttings from the higher region of the stem. In such cases the sheath was split open gently, which facilitated the emergence of buds. The cuttings were then planted either vertically or horizontally in pots filled with river sand and watered daily. In vertical planting the nodes were placed partially under the soil.

Roots were seen emerging from the base of the nodes on the second day onwards when no symptoms of growth of the bud could be noticed. Gradually swelling and elongation of the buds and splitting of the leaf sheath were noticeable a week after planting and the buds emerged after a fortnight. Whenever the development of buds was advanced at the time of planting, these emerged earlier and roots arose from the base of the bud later and these ultimately grew into normal plants (Fig. 1). Too much of water completely decayed the cuttings. Seedlings of these two varieties, thus raised, were transplanted in pots which eventually produced panicles. In PTB. 10 the panicle emerged a month after transplanting and these were not very long. But in the other variety, P.H. 37, the panicle emerged after two and a half months.

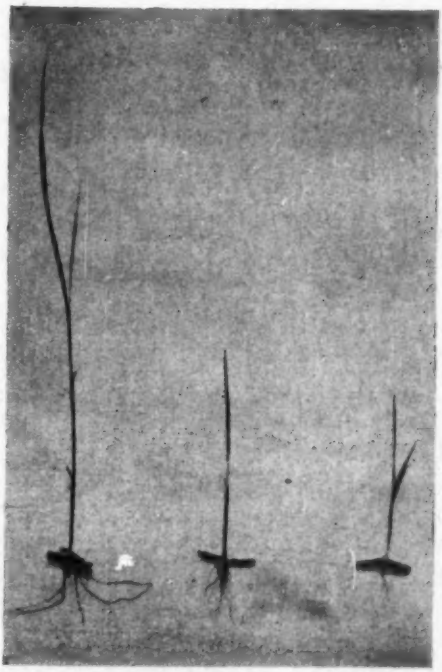


FIG. 1

An interesting possibility thus exists to obtain larger number of plants by stem cuttings than by planting stubbles to carry forward hybrids and other valuable material to the next season and for obtaining a large quantity of seeds. Whether all the cultivated varieties of rice can be propagated by stem cuttings or whether such a vegetative propagation is practicable on a large scale are matters that require further studies.

The authors are working in a scheme partly financed by the Indian Council of Agricultural Research and help from the Council is duly acknowledged.

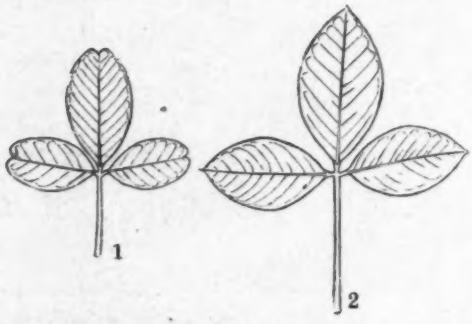
Rice Section,
Department of Agric.,
Trichur (Kerala State),
July 17, 1961.

N. R. NAIR
P. C. SAHADEVAN.

1. Ramiah, K., *Rice Breeding and Genetics—Scientific Monograph No.* 19, I.C.A.R., New Delhi, 1950.
2. Israel, P. and Veda Moorthy, G., *Curr. Sci.*, 1958, **8**, 309.
3. Reddy, V. R. and Pawar, M. S., *Andhra Agric. J.*, 1959, **6** (2), 70.

INHERITANCE OF THE RETULE (NOTCHED) LEAF APEX IN A CROSS BETWEEN *CROTALARIA STRIATA* DC. AND *C. MUCRONATA* DESV.

Crotalaria striata, a promising green manure plant in South Indian plantations is often referred to as *C. brownii* Bert, *C. saltiana* Andr., and *C. mucronata*.[1] In order to solve the nomenclatural confusion, morphological and cytogenetical observations are in progress at this Institute. In the present note a brief account on the inheritance of leaf apex in reciprocal crosses between *C. striata* and *C. mucronata* is presented.



FIGS. 1–2. Fig. 1. Leaf of *C. mucronata*. Fig. 2. Leaf of *C. striata*.

TABLE I

Inheritance of leaf apex in reciprocal crosses between Crotalaria striata *and* C. mucronata

Cross No.	Female parent	Male parent	F_1	F_2 No. of plants: Acute leaf apex	F_2 No. of plants: Retule leaf apex
3	*C. striata*	*C. mucronata*	Retule leaf apex	72	240
	Expected on 3 : 1 Ratio		..	78	234
4	*C. mucronata*	*C. striata*	Retule leaf apex	34	138
	Expected on 3 : 1 Ratio		..	43	129
	X^2 for cross No. 3 = 0·572				
	X^2 for cross No. 4 = 2·511				

Leaf apex is 'acute' in *Crotalaria striata* and 'retule' with a shallow notch in *C. mucronata* (Fig. 1). Reciprocal crosses between these two plants were effected. The hybrid generation in both the crosses exhibited the retule apex indicating the dominant nature of this character. The F_2 population was raised and individual plants were studied for leaf apex character. The data on appearance of F_1 and segregation in F_2 generations are given in Table I.

From Table I it may be concluded that the leaf apex character is controlled by a single gene as exhibited by the monohybrid ratio.

We are thankful to Shri B. Venkoba Rao, Principal, for providing facilities and to Dr. H. C. Govindu, Plant Pathologist (Research and Education), for help in preparation of the manuscript.

Division of Botany, Agric. College and Research Institute, Hebbal, Bangalore-6, *May* 2, 1961.

S. R. CHANDRASEKHARIAH.
N. S. PARAMESWAR.

1. *The Wealth of India* (Raw materials), C.S.I.R., New Delhi, 1950.
2. Kempanna, C. and Chandrasekhariah, S. R., *The Mysore Agric. Jour.*, 1960, **35** (1), 9.

NUCLEOLAR NUMBER AND POLYPLOIDY LEVEL

THE number of nucleoli per nucleus has been considered as a fairly reliable criterion to indicate the level of polyploidy in a number of plants.[1–3,7] This is based on the assumption that each genome carries one nucleolus-organizing chromosome. A good number of workers have, however, found contrary results.[4–6,8] While studying the cytology of endosperm in *Zephyranthes ajax*, *Z. grandiflora* and *Nothoscordum fragrans* we made certain observations which have an important bearing on the relationship between nucleolar number and polyploidy level. These are discussed in the present note.

The chromosome number of *Zephyranthes ajax* as determined from the root tips was $2n = 42$. Eighty-five per cent. of the endosperm nuclei showed 84 chromosomes. This indicates that the normal cytological constitution of the endosperm in *Zephyranthes ajax* is tetraploid. It may be mentioned that the work regarding the origin of tetraploid nuclei in the endosperm is in progress. Some of the tetraploid nuclei of the endosperm at prometaphase in *Zephyranthes ajax* showed fewer than four nucleoli. The size of these nucleoli in most of the cases was

in no way different from those where four nucleoli per nucleus were present. In a few nuclei where an increase in the size of the nucleoli was noticed, it was not in proportion to the decrease in number. Although the number of nucleoli per nucleus, in general, in the endosperm ranged from one to forty, the range in polyploidy in the tissue was from 4 *n* to 16 *n* only. The observations in the endosperm were supported by the fact that the maximum number of nucleoli per nucleus was five in the cells of the root which represented the diploid tissue.

FIG. 1. A triploid nucleus with five nucleoli at prometaphase in *Nothoscordum fragrans*.

The root tips of *Zephyranthes grandiflora* showed $2n = 24$. The majority of endosperm nuclei showed $3n = 36$. Some of the triploid nuclei of the endosperm underwent endo-mitosis as a result of which hexaploid nuclei were formed. The fusion of a hexaploid nucleus with a nucleus showing haploid number contributed to the formation of 7-ploid nucleus. It may be stated that endosperm nuclei with haploid numbers were formed as a result of irregular distribution of chromosomes during anaphase. Whereas the highest polyploidy level in the endosperm of *Zephyranthes grandiflora* was 7-ploid, the maximum number of nucleoli per nucleus was twenty-three. The endosperm of *Nothoscordum fragrans*, in general, also showed a higher number of nucleoli per nucleus in comparison with its polyploidy level. A good number of triploid nuclei at prometaphase showed five nucleoli per nucleus (Fig. 1). Our findings thus clearly show that the nucleolar number cannot be used as an Index for determining polyploidy level in the endosperm of *Zephyranthes ajax*, *Z. grandiflora* and *Nothoscordum fragrans*.

We are grateful to Professor P. Maheshwari, Head of the Botany Department, University of Delhi, for the facilities and encouragement. The observations reported in this paper are from part of the work which is being done under a research scheme sanctioned by the Council of Scientific and Industrial Research, New Delhi.

Dept. of Botany, University of Delhi, Delhi-6, *May* 2, 1961.

S. L. TANDON.
B. M. KAPOOR.

1. Bhaduri, P. N. and Bose, P. C., *J. Genet.*, **1947, 48**, 237.
2. —, Kar, A. K., *Bull. Bot. Soc. Bengal*. **1948, 2**, 1.
3. Bhatia, G. S., *Ann. Bot. N.S.*, **1938, 2**, 335.
4. Hakansson, A. and Levan, A., *Hereditas*, **1942, 28**, 436.
5. Heitz, E., *Planta*, **1931, 15**. 495.
6. Matsuura, H., *Cytologia*, **1938, 9**, 56.
7. Pathak, G. N., *Ann. Bot. N S.*, **1940, 4**, 227.
8. Sato, D., *Cytologia, Fujii Jub*, **1937, 80**.

PRELIMINARY STUDIES ON PRESOAKING OF CEREALS IN ANTIBIOTICS

AT places where wheat and barley are grown in tank beds, the sowings are usually delayed by four to six weeks. Late sowings are also unavoidable in large holdings. Such late-sown crops normally suffer from diseases and insect pests and yields are poor. Presoaking seeds of cereals by various hormones and chemicals have been extensively tested and reported. The use of antibiotic on the rate of pollen tube growth (Sen, 1960) indicated that the growth rate was retarded. Balchandran *et al.* have reported on the control of black arm disease in cotton by spraying antibiotics at three stages of growth. The presoaking of cotton-seed in antibiotics, however, did not give any conclusive results.

A presoaking seed treatment study was undertaken on wheat and barley using Antibiotic (Penicillin G. Sodium). Each vial of antibiotic-200,000, 400,000 and 10,00,000 units was dissolved in 50 ml. of water and the seeds were soaked for 24 hours before sowing. The sowings in the experiment were done on 30th November

1959, i.e., 45 days later than normal sowing, in a randomised replicated trial with the following treatments and a plot size of 6½ × 13 ft.

T_1.....Seeds soaked in water, no manuring.
T_2.....Dry seeds sown, manuring with 40 lb. N & P per acre.

T_3.....Seeds soaked in 2 lac unit solution of antibiotic, no manuring.
T_4.....Seeds soaked in 2 lac unit solution, manuring with 40 lb. N & P per acre.

T_5.....Seeds soaked in 5 lac unit solution, no manuring.
T_6.....Seeds soaked in 5 lac unit solution, manuring with 40 lb. N & P per acre.

T_7.....Seeds soaked in 10 lac unit solution, no manuring.
T_8.....Seeds soaked in 10 lac unit solution, manuring with 40 lb. N & P per acre.

Barley.—Barley grain yields also follow, more or less, the same pattern as that of wheat. However, highest concentration soaking has given highest yields. Bhusa yields follow the same trends as that shown with grains.

The results of presoaking seed with antibiotic have shown some interesting trends. It was observed that the crop was disease free and healthy, distinctly more green in colour than their respective controls T_1 and T_2, and in addition they have given higher yields with marked combination and interaction with manures. Results of importance are noticed as without addition of manures the yields could increase appreciably.

The authors are thankful to Shri Samrath Raj, Director of Agriculture, Rajasthan, Jaipur, for providing necessary facilities.

TABLE I

Average grain and bhusa yields and percentage increase over control in lb. per plot

Treatments	Wheat				Barley			
	Grain yields	% increase over control	% increase over T_2	Bhusa yields	Grain yields	% increase over control	% increase over T_2	Bhusa yields
T_1	3·36	..	..	5·63	3·07	..	..	5·51
T_2	5·14	52·9	..	7·69	4·59	49·5	..	6·86
T_3	6·81	102·6	32·4	7·18	10·52	242·6	130·5	9·64
T_4	8·51	153·2	−65·5	8·99	9·28	202·2	102·1	8·94
T_5	8·96	166·6	−74·3	9·28	10·64	246·5	131·8	8·88
T_6	8·12	141·6	−57·9	8·56	9·28	202·2	102·1	8·34
T_7	8·37	149·1	−62·8	8·34	12·36	302·6	169·2	10·78
T_8	8·12	141·6	−57·9	9·46	11·61	278·2	131·1	11·08
C.D. at 5%	0·836	..	..	0·703	0·160	..	..	0·384

Wheat.—Wheat grain yields were significantly affected by the soaking treatments. Antibiotic in lower concentration served the purpose of field manuring. Higher concentrations beyond 500,000 units do not appear to benefit the crop appreciably. Similar significant trends as in grain are visible for bhusa yields.

Department of Agronomy,
Agriculture Department,
Rajasthan,
February 24, 1961.

M. P. BHATNAGAR.
UDAI BHAN SINGH.
G. S. SHEKHAWAT.
B. N. MATHUR.

1. Balchandran *et al.*, *Madras Agric. Jour.*, Jan. 1960, 47 (1).
2. Sen, S. K., *Indian Agriculturist*, Jan. 1960, 4 (1).

REVIEWS

Lectures on Linear Algebra. By I. M. Gel'fand. Interscience Tracts in Pure and Applied Mathematics. (Interscience Publishers, New York, London) 1961. Pp. ix + 185. Price $ 6.00.

A good many text-books for post-graduate courses (in the Indian, not the American, acceptation of the term) have been written recently by leading Mathematicians. This is undoubtedly an extremely important and welcome development. It should contribute greatly to improve the quality of Mathematical Education, so often victim of an inordinate attachment to defective traditions and of second-rate books. Academician I. M. Gel'fand needs no introduction and one could easily foresee, before opening his *Lectures on Linear Algebra*, the conclusions which its perusing will confirm. This little book of 185 pages is a masterpiece of clarity and probably the best introduction to the subject which may be recommended at present. The first two chapters deal with the classical notions of finite dimensional spaces, linear and bilinear forms and linear transformations. The subject-matter of the third chapter is less elementary : this chapter is about the theory of canonical matrices, including the main theorems on elementary divisors. Making use of an idea due to I. G. Petrowsky, the author has succeeded in proving these last theorems with an admirable simplicity. No doubt van der Waerden's proofs are also very simple, but they require a good knowledge of Modern Algebra whereas I. M. Gel'fand's proofs are elementary and yet astonishingly short and elegant. The last chapter, about tensors, is only an elementary introduction to this vast field. Only some essential definitions are given. There is no mention of any application. I. M. Gel'fand's lectures should be in the hands of every good post-graduate student.

C. RACINE.

Space Trajectories. Edited by the Technical Staff, Research Division, Radiation Inc. (Academic Press, New York and London), 1960. Pp. x + 298. Price $ 12.00.

The above volume incorporates the proceedings of a two-day symposium organised by the American Astronautical Society and the Advanced Research Projects Agency, and is intended to assemble in one publication a comprehensive survey of space trajectory analysis as it existed in 1960. Accordingly it consists of a number of invited papers from applications who summarise the present status of knowledge of space science in its varied aspects, *viz.*, orbit determination, astrodynamics, trajectory computation and re-entry problems.

Satellites and space probes have in the recent past been instrumental to several important discoveries of scientific value. It has been found that the earth is slightly pear-shaped with the stem at the North Pole and that the atmosphere is denser than what it was supposed to be. Satellites have revealed the existence of great radiation belts surrounding the earth and it has been found that there are several zones of trapped charged particles around the earth. The first two chapters of the book give a general survey of the American space programme and its achievements in the technological and scientific fronts.

The mathematical problem of a satellite orbit can be stated as the motion of a particle in the gravitational field of the earth and in the field of a few perturbing forces which are caused by the oblateness of the earth, the atmospheric drag and the gravitational pull of the sun and the moon. Several numerical methods have been devised to calculate the effects of the perturbing forces and these are discussed in the chapter entitled "Astrodynamics". The numerical computation of the trajectories of the satellities calls for the design of complex computers and not less than five chapters of the book are devoted to themes centering round computer design and computer programmes for space missions.

Two other important aspects of space research concern attitude control and the problems of re-entry of a space vehicle into the earth's atmosphere. A scientist should know not only where his satellite is roving about but also the directions toward which his instruments point out. Again the problem of re-entry into the earth's atmosphere poses several difficulties. These questions also have been touched upon by the various authors participating in the symposium.

The book is a valuable addition to the literature on space research.

K. S. V.

Advances in Catalysis and Related Subjects (Vol. XII). Edited by D. D. Eley, P. W. Selwood and P. B. Weisz. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1960. Pp. x + 324. Price $ 11.00.

A catalyst, as it was—and perhaps is still—taught in schools, was a substance which accelerated a reaction without participating in it. While one feels that there is something catalytic in the rate at which these volumes are being published, one is also happily assured that the authors are active participants and have made significant contributions in this unique and growing field of research, which is still imperfectly understood in all its details. No doubt deep researches on the nature of crystal structures, the geometrical positions of electrons, ions or atom groups and their energetic conditions, their mobilities within the lattice and at phase boundaries have all helped in a large way to throw much light on the mechanism of catalysis. Still the field is wide and the problems are many and varied.

This volume contains six contributions reviewing recent advances in this field of interest. In the first article on "The wave mechanics of the surface bond in chemisorption", T. B. Grimley, shows how the conventional orbital theory can be applied to the problem of chemisorption on solids.

Nuclear magnetic resonance (NMR) and electron paramagnetic resonance (EPR) provide unique information on the microscopic properties of solids, such as symmetry of atomic sites, covalent character of bonds, strength of exchange reactions, etc. Since the catalytic characteristics of solids are related to the detailed electronic and geometric structure of solids, one can find a correlation between the results of magnetic resonance studies and catalytic properties. D. E. O'Reilly surveys this field in the article on "Magnetic resonance techniques in catalytic research".

The acid-catalyzed conversions of hydrocarbons have been extensively studied, and their applications to petroleum and petrochemical processes are known. On the other hand, the use of bases to catalyze hydrocarbon conversions has received little attention. In the article on "Base-catalyzed reactions of hydrocarbons" H. Pines and L. A. Schaap discuss the use of base catalysis for olefin isomerization, cyclohexadiene dehydrogenation, aromatic alkylation, and olefin polymerisation. These reactions are still imperfectly understood. Catalytic mechanisms involving carbanion intermediates have been used to explain the reactions, and theoretical interest in carbanion chemistry is growing.

R. A. Van Nordstrand has discussed the use of X-ray K-absorption edges in the study of catalytically active solids.

In a detailed article Th. Wolkenstein presents an account of the present state of the electron theory of catalysis on semiconductors. The article includes a summary of the results of work on electronic phenomena in catalysis, carried out mainly in U.S.S.R., in recent years.

The last article is on "Molecular specificity in physical adsorption" by D. J. C. Yates. Although it is generally believed that physical adsorption is essentially non-specific in nature, particularly when non-polar gases are used as adsorbates, Yates shows that specificity is almost as prevalent, although not as obvious, in physical adsorption as in chemisorption. The application of infra-red spectroscopy to the problem has enabled significant results to be drawn on the changes a molecule undergoes on adsorption. Thus the appearance of new bands in the spectra of adsorbed molecules, at frequencies which correspond to Raman frequencies shows directly the existence of induced dipoles in them.

A. S. G.

Error Correcting Codes. By W. W. Peterson. (The MIT Press and John Wiley and Sons, Inc., New York), 1961. Pp. x + 282. Price $ 7.75.

The author of this book has been associated with the IBM and the MIT, and has justified this association in the writing of this book. It is, to some extent, novel in its title, the subject-matter, and the manner of presentation.

The book is restricted in scope in the sense that it deals exclusively with error-detecting and error-correcting codes for information, transmission and storage systems. The first five chapters are concerned with the well-known coding theory and systems. The last seven chapters are devoted to developments during the last three or four years. During this period, there has been, in one sense, a considerable volume of contributions, but, in another, really very little! Under the circumstances, sifting material and presenting it is a difficult task which the author has tried to accomplish reasonably well. Of the five appendices in the books two provide valuable information, *viz.*, one giving a table for the entropy function and the other giving a table of irreducible polynomials over GF (2). There is also a novel appendix which lists the sections of the book that must be read before deciding to read a particular chosen

section in the book. The first ten chapters can be considered as a course on information theory.

The book should be useful to information theorists, data transmission engineers and computer engineers. The author has avoided using concepts of homomorphism and isomorphism, but considers the properties of finite fields important, and so on. These are, undoubtedly, matters of opinion. However, they do not reduce the value of the book which has certainly a place as a contribution of current interest.

The printing and get-up of the book is good and the diagrams are neatly drawn.

S. V. C.

Perspectives in Virology, Vol. II. Edited by Morris Pollard. (Published for the Gustav Stern Foundation of New York, Burgees Publishing Co., Minneapolis). Pp. x + 220. Price $ 8.00.

The Publication represents the proceedings of a symposium held in New York during January 1960 sponsored by Gustav Stern Foundation in honour of Dr. Peyton Rous. He was honoured by the participants of this symposium on the fiftieth anniversary of his report on the Rous Sarcoma and his eightieth birthday.

The information contained in this book ranges from fundamentals of Virology to Applied Biology in its 15 chapters described in about 200 pages. The subject-matter is varied. To mention a few—Studies on Polio Virus, origin, time of synthesis; Studies on Kappa particles; Structure and composition of viruses; Nature and function of 'Interferon' and potentialities of further research.

Anyone who had the opportunity of participating in the symposium would appreciate the true description of the articles presented and the discussions that followed. The remarkable growth of knowledge in Virology in recent time is strikingly seen by every reader. This amply justifies the necessity of conducting similar symposia more frequently in different countries.

The author Dr. Morris Pollard is not only a veteran virologist but also a professor of Preventive Medicine in a leading University in U.S.A. He creditably shouldered the responsibility of organising and conducting the above Symposium in which more than a hundred eminent Virologists from several countries participated.

The several exciting new developments in Virology is bound to attract and stimulate the interests of both Plant and Animal Virologists. The book is sure to serve as a useful 'Reference Book' in every Virus and Biochemical Laboratory engaged in fundamental research work.

D. P. Narasimha Murthy.

Carcinogenesis. By I. Hieger. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1961. Pp. 138. Price 35 *sh.*

It is true that our understanding of the cancer problem is inversely proportional to the number of theories put forth to explain it. The fact that there are a number of theories on carcinogenesis speaks volumes about the inadequacies of our knowledge of the disease and the processes that lead to it. An authoritative book to take stock of the various theories and to weed out the untenable has been wanting for a long time. The book on "Carcinogenesis" by I. Hieger tries to cover up the possible avenues of experimental carcinogenesis. The author has taken pains over stating his own critical views about the present state of our knowledge on carcinogenesis. He further has submitted the work of Darlington, Green, Burnet, Coulson, Badger, Haddow, Huxley, Lederberg and Muller (Chapters 1 to 4) to sharp criticism. The author is fully aware of the lengthy quotations from the reviews and references which have been profusely used.

Chapters 5 and 6 on "Carcinogenesis as a multistep process" and the work of Earle, Warburg and Cowdry are well written.

A few printing errors have occurred on pages 38 and 81.

On the whole the book on "Carcinogenesis" appears to be a critical commentary and gives a balanced account of the present position of our knowledge on the processes of carcinogenesis. It would, therefore, be of more value to a person who is intended and well versed in cancer research.

V. R. Khanolkar.

Illustrated Genera of Wood Decay Fungi. By Charles L. Fergus. (Burgess Publishing Company; Minneapolis, Minnesota), 1960. Pp. i-iv + 132. Price $ 4.00.

The appearance of this manual reflects the current interest in fungi which cause decay in wood. The difficulty of proper identification of these fungi is known to all those who are interested in this group and admittedly the main purport of a manual on this group should be to solve this difficulty. In the words of its author, the book is intended to provide a means for the identification of wood decay fungi and to help particularly those not trained in mycology and

who lack the taxonomic experience and information of the sources of relevant taxonomic literature.

There is a short introduction on the use of the Keys and directions for the collection of the fungi, followed by a Key to the Families, a supplementary Key to the common genera, Keys to the genera of the Families, a list of general references, a glossary and an index to the genera. Eighty-one genera, all belonging to the Basiliomycetes, are included. While it is true that the majority of the fungi causing decay in wood belong to this group, the omission of some of the Ascomycetes such as species of *Ustulina* and *Xylaria* and of several operculate and inoperculate Discomycetes lends a halo of incompleteness to the work. Indeed, these could well have been included in place of such genera as *Exobasidium, Septobasidium, Tremellodendron, Clavariadelphus, Clavulina,* etc., which either cause no decay at all in wood or are not important from this angle. Species of *Exobasidium,* for example, cause galls mainly on leaves. *Septobasidium* spp. occur in association with scale insects. The inclusion of both these genera in this manual is misleading. On the other hand, *Ganoderma* Karst. (Polyporaceæ) is not mentioned, although species of this genus commonly attack wood.

Several important taxonomic papers on wood decay fungi are listed under "General References", but this list could have been more exhaustive. It is surprising that the nomenclature of the fungi mentioned has not been brought in line with recent revisions, many of which are quoted but not followed. For instance, *Tremelledon* (Pers.) Fr. (p. 24) is used in place of *Pseudohydnum* Karst., and *Guepinia* Fr. (p. 32) in place of *Dacryopinax* Martin. The author citations for the genera will have to be carefully checked from the references given or from other monographs. The author citations for the species mentioned are not given. A manual like this should not only provide accurate and clear descriptions of the various fungi but should also be sound and reliable in regard to the nomenclature of the fungi. In regard to the latter, the text falls short of the requirements. The Keys form an important part of the text, but it is not clear how *Aleurodiscus oakesii* is keyed out under *Stereum* (p. 50). On page 69 we find that species of different genera are keyed out together and the following statement is appended: "All of these important tooth fungi are designated as species in pathology text-books such as Baxter and Boyce"! Again, on page 81 species of different genera are presented in the same Key under the genus *Irpex* and then it is stated that "species that are most often confused with *Irpex* have been included in the Key for ease of identification".

The book is admirably illustrated with good photographs. The materials for a revision of this work will be found in the literature quoted under General References and it is hoped that the author will soon provide us with a revised text which will be more reliable. Until then the book will be found useful by those who are trained in mycology and who know at least some of the basic principles and pitfalls in the nomenclature of fungi.

C. V. SUBRAMANIAN.

Beautiful Climbers of India. By B. P. Pal. (Indian Council of Agricultural Research, New Delhi), 1960. Pp. 105. Price Rs. 8.

This superbly illustrated little book is another very commendable publication in the authoritative series on horticulture and ornamental gardening being published by the I.C.A.R., New Delhi.

We do not have much horticultural literature adapted to indigenous needs—not even good nursery catalogues which can compare with their glossy, profusely illustrated counterparts abroad giving plenty of useful information, albeit with a commercial slant. Nor do we have in this country any class of gardening experts as such, similar to the experienced nursery-men and knowledgeable head-gardeners of the west. We have, instead, a minority highly qualified in botany, agriculture, or allied science who come to gardening *via* their subject, or at the other extreme, the near-illiterate *malis* with some individually garnered practical knowledge. Aspiring amateur gardeners, such as those building houses and/or laying out new gardens, have either to go by rule of thumb or burden themselves with scientific data. In such a context a book like the one under review is of considerable utility. Here is contained accurate information based on personal experience and written in a language easily intelligible to the layman.

Following a brief Introduction, Chapter I gives practical hints on growing the various types of light and heavy climbers, and positions suited to particular ones. Chapter II gives further information on the same lines and is helpful in making a choice. Chapter III deals in detail with about 30 select climbers and is interspersed with excellent illustrations in full colour. The climbers are described as to habit, floral and other peculiarities, and manner of growth and propagation.

Nearly all of the climbers described are extraordinarily lovely yet common enough to be readily obtainable. No one can look unmoved on the glorious *wistaria, pyrostegia, banisteria, petrea, Mina lobata, clerodendron* (particularly *C. splendens*), or the *bougainvillea* Mary Palmer. Even the universally met with antigonon, jacquemontia, rambler roses, allamanda or common bougainvilleas have their own appeal. They have their place and always will, whatever the dizzy heights of hybridization, yet to be reached.

A minor point regarding the book may be mentioned: While indicating the size of flowers, it could have been given in approximate number of inches as the terms large and small are variously interpretative, and the close-up pictures of certain blooms,—*e.g., Allamanda banisteria, Beaumontia grandiflora*—may be quite misleading to one who has not seen them in growth.

Among scented flowered creepers the Indian cowslip (*Pergularia odoratissima*) and the creeping tuberose (*Stephanotis floribunda*) could with advantage have been included without noticeable enlargement of the book. But as Dr. Pal points out a selective list has to be perforce arbitrary.

A very useful table is appended containing botanical and common names and characteristics of the climbers together with the season of flowering. The index at the end is useful for referring to species and varieties. *Beautiful Climbers of India* is a book that should find a place in all school and college botany libraries as well as prove of general popular appeal.

I. H.

General Physical Science. By G. G. Mallinson, J. B. Mallinson and R. F. Welch. (McGraw-Hill Book Co., New York), 1961. Pp. xii + 628.

This is a book of General Knowledge in science and presents in a most interesting manner the basic principles of the physical sciences and their applications in chemistry, physics, geology, astronomy and meteorology. The developments that have taken place in the last decade or two in physics have made general physical science a highly popular course in high schools. Although the book is essentially written for the benefit of the high school students, grown-ups can supplement their knowledge by the up-to-date information provided here in various areas of popular science. The book will be particularly of use to students in India who take competitive examinations which include a paper on General Knowledge (Science). The illustrations are both instructive and attractive. The get-up is excellent.

A. S. G.

Basic Principles of Fission Reactors. By W. R. Harper. (Interscience Publishers, New York), 1961. Pp. viii + 314. Price $ 7.50.

Time is not far off when the essentials of Reactor Physics and Technology will have to be included as part of the regular course to post-graduate students in science and engineering in Universities in India, as it is being done in those of the scientifically more advanced countries. Even now there are a small number of institutions in the country which cater to this and there are quite a few students of science and engineering who are interested in the subject. To them this book on the "Basic Principles of Fission Reactors" can be recommended as an introduction to the subject. The treatment is such as will take the reader with the ordinary background knowledge of physics and mathematics to about the stage at which detailed reactor design begins. The reactor itself forms the main subject of the book, but ancillary topics such as radiation protection, health physics, waste disposals, etc., have also been briefly referred to.

Physical Chemistry (2nd Revised Edition). By E. A. Moelwyn-Hughes. (Pergamon Press, London, W. 1), 1961. Pp. vii + 1,333. Price 84 *sh.*

This outstanding text-book on Physical Chemistry written by an experienced teacher of the subject needs no introduction or elaborate reviewing. It became immediately popular as soon as it was first published in 1957. It is not surprising that there has arisen a demand for its reissue. In the second edition the author has taken care to revise the text in the light of more recent advances and bring the book up-to-date.

Analytical Elements of Mechanics, Vol. 2—Dynamics. By T. R. Kane. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1961. Pp. xvi + 337. Price $ 6.25.

This is the second of the twin volumes on "Analytical Elements of Mechanics" by Prof. T. R. Kane, intended for use in Engineering courses. The first volume deals with Statistics and the present volume is concerned with Dynamics. As before the symbolic language used is vector analysis.

According to the author the greatest obstacles standing in the way of effective solution of problems in particle and rigid body dynamics are inadequate understanding of kinematics and theory of moments and products of inertia of rigid bodies. Accordingly the author has devoted much attention to these topics and the treatment also is from a new approach.

More than a hundred illustrative problems are worked out in the text. Like its companion volume on Statics the present volume will be of value to students of engineering and technology.

Proceedings of the Natural Rubber Research Conference 1960. (The Rubber Research Institute of Malaya, P.O. Box 150, Kuala Lumpur, Selangor, Federation of Malaya), 1961. Pp. xix + 986. Price $ 23 (Malaya), $ 7.50 (U.S.) or £ 2-13-8 (postage extra).

International Conferences on natural rubber research have been few and far between. Since the end of World War II there have been only two Conferences of this kind, one in Malaya in 1950, and the other at Bogor in 1952. The 1960 Conference held in September 26–October 1, in Malaya, however, surpassed the previous two, both in the number of participants and in the range of subject covered.

About 300 participants from twenty different countries from all the five continents attended the Conference, and they included not only research workers but also those concerned with the growing of rubber, the manufacture, and the organisation of the industry.

With the advent of synthetic rubbers the almost unchallenged position that natural rubber held for over fifty years has changed, and there is need to intensify research work on natural rubber in all its different phases of growth, manufacture, processing and marketing. This voluminous report of the *Proceedings of the Natural Rubber Research Conference* bears testimony to the progress that is being made in these directions.

The 1,000-page report is in three parts. Part I contains the proceedings of the General Sessions which includes amongst others the addresses of Professor James Bonner on *The Biogenesis of Rubber*, of Prof. G. E. Blackman on the *Stimulation of Latex Flow by Plant Growth Regulators*, and of Prof. G. Gee on *New Methods of Elastomer Synthesis and their Impact on Natural Rubber*. Part II contains 34 papers covering various aspects of Natural Rubber Production, and Part III 42 papers on Preparation and use of latex, its chemistry and technology, its biochemistry and microbiology.

The volume containing as it does the latest information and results of research on the subject should be in the possession of all organisations which have anything to do with natural rubber and natural rubber research.

Books Received

Spectroscopy (Vol. 1). *Atomic, Microwave and Radio-frequency Spectroscopy*. By S. Walker, and H. Straw. (Chapman and Hall, London, W.C. 2), 1961. Pp. xix + 267. Price 50 *sh.*

Scotland's Scientific Heritage. By A. G. Clement and R. H. S. Robertson. (Oliver and Boyd Ltd., London, W. 1), 1961. Pp. 151. Price 18 *sh.*

Scientific Research in British Universities 1960-61. (Department of Scientific and Industrial Research, Charles House, London, S.W. 1), 1961. Pp. xiii + 513. Price 12 *sh.* 6 *d.*

The Rare Earths. By F. H. Spedding and A. H. Daane. (John Wiley and Sons Inc., New York-16; India: Asia Publishing House, Bombay-1), 1961. Pp. xi + 641. Price $ 14.75. From: Academic Press, 111, Fifth Avenue, New York-3; India: Asia Publishing House, Bombay-1:

International Review of Cytology (Vol. 11). Edited by G. H. Bourne and J. F. Danielli, 1961. Pp. xii + 356. Price $ 11.00.

The Optimal Design of Chemical Reactors. By Rutherford Aris, 1961. Pp. xi + 191. Price $ 7.00.

Mechanisms in Radiobiology—General Principles. Edited by Maurice Errera and Arne Forssberg, 1961. Pp. xv + 534. Price $ 16.00.

Interfacial Phenomena. By J. T. Davies and E. K. Rideal, 1961. Pp. xiii + 474. Price $ 14.00.

Fish as Food (Vol. 1). *Production, Biochemistry and Microbiology*. Edited by G. Borgstrom, 1961. Pp. xv + 725. Price $ 24.00.

Physical Chemistry (Vol. 9). *Photochemistry of Air Pollution*. By Philip A. Leighton, 1961. Pp. ix + 300. Price $ 11.00.

The Cell (Vol. 11). *Biochemistry, Physiology, Morphology*. Edited by J. Brachet and A. E. Mirsky, 1961. Pp. xiv + 916. Price $ 25.00.

Advances in Agronomy (Vol. 13). Edited by A. G. Norman, 1961. Pp. xi + 386. Price $ 12.00.

Advances in Applied Mechanics (Vol. 6). Edited by H. L. Dryden, Th. von Karman and G. Kuerti, 1961. Pp. x + 294. Price $ 9.00.

Protein Structure. By Harold A. Scheraga, 1961. Pp. xi + 305. Price $ 8.00.

SCIENCE NOTES AND NEWS

Award of Research Degrees

Andhra University has awarded the D.Sc. Degree in Physics to Miss V. Sarojini for her thesis entitled "Experimental Investigations on the Dielectric Behaviour of Certain Liquid Mixtures; D.Sc. Degree in Chemistry to Messrs. Ch. Bheemasankara Rao and N. Venkateswara Rao for their theses entitled "A Study and Synthesis of the Chemical Constituents of Some Indian Medicinal Plants and Related Compounds" and "Oxidemetric Methods for the Determination of Dyes and Studies on the use of Phthalocyanines as Oxidation-Reduction Indicators" respectively; D.Sc. Degree in Pathology to Sri. S. S. Sriramacharyulu for his thesis entitled "Studies on the Pathogenesis of Dictary and Toxic Cirrhosis of the Liver"; D.Sc. Degree in Geology to Sri. M. Satyanarayana Murty for his thesis entitled "Structure, Mineralogy and Petrology of Charnockite Series and Associated Rocks of the Visakhapatnam Area".

Utkal University has awarded the Ph.D. Degree in Chemistry to Shri Bhaskar Das for his thesis entitled "Thiazole Derivatives".

Bombay University has awarded the Ph.D. Degree in Physics to Shri M. G. Joshi of Tata Institute of Fundamental Research for his thesis entitled "Measurement of Internal Conversion Coefficients and Energy Levels of Some Nuclei"; Ph.D. Degree in Cytology to Shri N. V. Aswathanarayana for his thesis entitled "The Vacuole and the Nucleus of *Saccharomyces cerevisiæ* and *Saccharomyces bayanaus*".

The Raptakos Medical Research Board Fellowships

The Raptakos Medical Research Board Fellowships for the year 1962 have been awarded to the following candidates: Dr. Prasanta Basu, Institute of Post-graduate Medical Education and Research, Calcutta; Dr. Naunihal Singh, All-India Institute of Medical Sciences, New Delhi; Dr. Tarakdas Banerjee, Nilratan Sircar Medical College, Calcutta; Mr. Ram Prakash Agarwal, K.G. Medical College and Lucknow University, Lucknow; Miss Vijayalaxmi Ramachandra Menon, J.J. Group of Hospitals, Bombay.

Symposium on Scombroid Fishes

The Marine Biological Association of India announces the holding of the Symposium on "Scombroid Fishes" from 12 to 15 January 1962 at Mandapam Camp. Of the 74 articles contributed to the Symposium, more than half the number come from 14 countries of the world outside India.

The Symposium is open to all members. However, non-members wishing to attend the Symposium may do so on payment of a "Symposium Fee" of Rs. 25. They will be entitled to receive the published proceedings of the Symposium at a concessional rate.

In view of the limited accommodation facilities available at Mandapam Camp, members desirous of attending the Symposium are requested to inform the Secretary, Marine Biological Association of India, Mandapam Camp, before 31 December 1961.

Two New Journals—*Experimental and Molecular Pathology* and *The Journal of Catalysis*

Academic Press, Publishers, New York and London, have announced the publication of the following two new journals in 1962: *Experimental and Molecular Pathology*, a new international journal, devoted to original papers on the application of traditional methods, as well as the newer techniques of analytical chemistry, histochemistry, pharmacology, toxicology, and electron microscopy, to problems of human and animal pathology. Dr. Frederick Coulston and Dr. Wilbur A. Thomas will be the editors of the new journal. Papers on virology, endocrinology, immunology, nutrition, chemotherapy, and geographic pathology, studies on the mechanism of action of drugs, vaccines, pyrogens, and other substances, when related to alterations in tissues, will be accepted. All articles will be in English. Volume I, consisting of six issues, will be released in 1962, at $ 18.00.

The *Journal of Catalysis* which will be a medium of publication for all original scientific studies in heterogeneous catalysis, as well as subjects related to homogeneous catalysis. Studies relating to catalytic properties with chemical processes at surfaces, including the study surfaces by various physical means, will be included in the scope of this Journal, as will molecular rate processes and studies of the chemistry of surfaces. Professors J. H. de Boer and P. W. Selwood have agreed to become editors of the new periodical.

Volume I, Number 1 is scheduled for release early in 1962.

Subscription orders should be sent to the publishers, Academic Press, Inc., 111, Fifth Avenue, New York-3, New York.

***Tolyposporium ehrenbergii* (Kuhn.) Pat.**

Dr. Mir Hamid Ali of the Department of Entomology and Plant Pathology, College of Agriculture, Osmania University, writes to say that *Tolyposporium ehrenbergii* (Kuhn.) Pat., the long smut of Sorghum has been recorded from the Mahboobnagar District (of the erstwhile Hyderabad State) for the first time. The measurements of this fungus agree with those reported by Kulkarni.

Sound Waves Trapped in the Solar Atmosphere

It has been suggested that the presence of a field of pressure waves may play a role in determining the fine structure and temperature of the solar atmosphere. According to the mechanism, first proposed by Lighthill, sound waves could be generated in a turbulent fluid. In the solar atmosphere the region of turbulence is identified with the convective layer in and just below the photosphere. Further the solar atmosphere has a distribution of temperature with a pronounced minimum of optical path $\tau = 0{\cdot}01$. Sound waves with a wide variety of initial directions, will therefore be prevented by refractive effects from leaving the region. At the level where the temperature is smallest, the local speed of sound waves increases in both directions away from this level. The waves will follow a sinusoidal path about this level with a spatial period.

F. D. Kahn (*Astrophys. J.*, 1961, 134, 343) has shown that the effect of these trapped sound waves is to produce a pattern which will tend to repeat itself at intervals of about 5 minutes, with distortions of about 2,250 km. This may lead to a 5-minute periodicity in the appearance of the fine structure of the sun. It is interesting to note that Leighton recently found that, viewed in certain spectral lines, the pattern of Doppler shifts in the Sun seemed to repeat itself after about 297 seconds. The agreement between Leighton's observations and Kahn's deductions suggests that there may be a connection between the two.

Hydrogen Cloud of Terrestrial Origin

Since the recent discovery of the diffuse Ly-α radiation in the night sky, it has been generally thought that this radiation was of interplanetary origin. It now seems that this hypothesis must be discarded because plausible models of the interplanetary medium contain much less neutral hydrogen than is required to explain the observations. An alternate hypothesis concerning the origin of the diffuse Ly-α radiation is that it may originate in a hydrogen cloud associated with the earth. A model was proposed according to which most of the scattering takes place in the geocentric distance 2·5–5 R_e (earth radius).

In a paper (*Astrophys. J.*, 1961, 134, 395) John C. Brandt presents evidence which indicates that the night-time Ly-α observations can be attributed to solar radiation scattered by a cloud of hydrogen of terrestrial origin located at geocentric distances greater than about 5-10 earth radii. It also appears that the earth has a comet-like tail of hydrogen in the antisolar direction. According to Brandt, hydrogen distribution can be idealized as being composed of two parts: a spherical distribution about the earth of 10 neutral hydrogen atoms per c.c. and of characteristic radius $10^2 R_e$. This distribution can be called the "geo-coma" and is mainly responsible for the Ly-α radiation; the second part is the "geo-tail"—a tenuous downward extension in the antisolar direction of characteristic length $10^3 R_e$, width $10^2 R_e$ and mean density 10^{-1}/cm.^{3}

Radioactive Wastes Fixed in Glass

With the expansion of the atomic energy industry, much attention is being devoted all over the world to the development of effective, safe and inexpensive methods for the disposal of radioactive wastes. Laboratory work over the last few years at the Chemical Engineering Division of the U.K. Atomic Energy Authority at Harwell, has shown that it may be possible to store the highly radioactive wastes by converting them into insoluble glass-like solids. Design of a pilot plant to handle 1,000 curies of active waste per batch has now reached an advanced stage.

The glass is produced by making a slurry of silica and borax in a nitric acid solution of the concentrated liquid wastes, which, when evaporated to red heat, sinters and melts, and on cooling solidifies to a glass of chosen composition. A typical product might contain from 20-30% by weight, of waste oxides.

Experimental work has shown that the properties of the glass remain substantially unchanged when samples are subjected to a radiation dose of 10^{11} rads. This dose is comparable with the dose received by a glass incorporating high activity waste which has been stored for 500 years.—(*Atom*).

Micrometeorite Layer at High Altitudes Around the Earth

The Air Force Cambridge Research Laboratories, Bedford, Mass., have announced the discovery of what appears to be a dense band of micrometeorites which envelopes the earth at extreme altitudes. This discovery was made recently when the contents of a novel rocket nosecone specially designed for trapping micrometeorites were examined. The nosecone was launched on June 6, 1961 at White Sands, New Mexico. The density of the micrometeorites in this layer was totally unexpected. About 10 of these small particles struck each square centimetre of the detecting surfaces each second. The dust particles measured in microns apparently exist as a band about the earth that is independent of latitude or longitude.

The special nosecone for trapping and recovering these micrometeorites consisted of a pod-like arrangement made up of individual petals or leaves. At an altitude of 47 miles these leaves opened like a blossoming flower. The nosecone was carried to a maximum altitude of 102 miles; the leaves closed again when the rocket descended to 65 miles. Altogether the nosecone remained open for about 4 minutes.

The micrometeorite detectors used consisted of a triple layer of physically separated Mylar and Plexiglas sheets each about 2" × 3". The top layer consisted of a mylar film ¼ mil. (1/4,000ths in.) thick; second layer, also of mylar was 1 mil. and the bottom layer was a ⅛" thick sheet of plexiglas. Detectors of this type were located on each of the leaves of the nosecone. The micrometeorites travelling at speeds up to 47 miles a second, passed through the two mylar film layers, creating many holes, most of which were microscopic in size. When they struck the harder plexiglas layer below, small craters readily visible were created.—(*J. Frank. Inst.*, 1961, 272, 248.)

Low Temperature Transformer

A new kind of transformer that may become a major innovation in power technology was described by its inventor Dr. McFee at a meeting of the American Institute of Electrical Engineers in Ithaca, New York. The new transformer has been successfully operated at a level of 15 kilowatts. Transformers using the new design could be considerably lighter and less costly than conventional transformers. And they would not be subject to the substantial power losses caused by electrical heating, or to the temperature limitations of present-day electrical insulation.

The new design makes use of superconductivity —the ability of certain metals to conduct an electric current without any resistance at temperatures near absolute zero. Superconducting transformers have been considered before, but the fact that a moderately strong magnetic field can quench the superconducting state by restoring electrical resistance presented an apparently insurmountable obstacle. When an electric current flows through a coil, such as the windings of a transformer, powerful magnetic fields are generated about the windings and quench the superconductivity when they reach a critical field strength.

Dr. McFee discovered that interleaving layers of the primary and secondary windings would keep the total magnetic field below the critical level. Since the current in adjacent layers flows in opposite directions, the magnetic fields generated about these layers are also opposing. In effect, the individual magnetic fields nearly cancel one another and eliminate the problem of magnetic quenching.

The Gifford-Mc Mahon helium refrigerator invented at A.D. Little Inc., provided a solution to another major problem in the development of a practical superconducting transformer. There had not been a simple, reliable method of maintaining the superconducting coils at the necessary low temperatures for an extended period. Now in its final stages of development, the new refrigerator will produce temperatures to − 452° F. and will maintain them unattended for months of continuous operation.

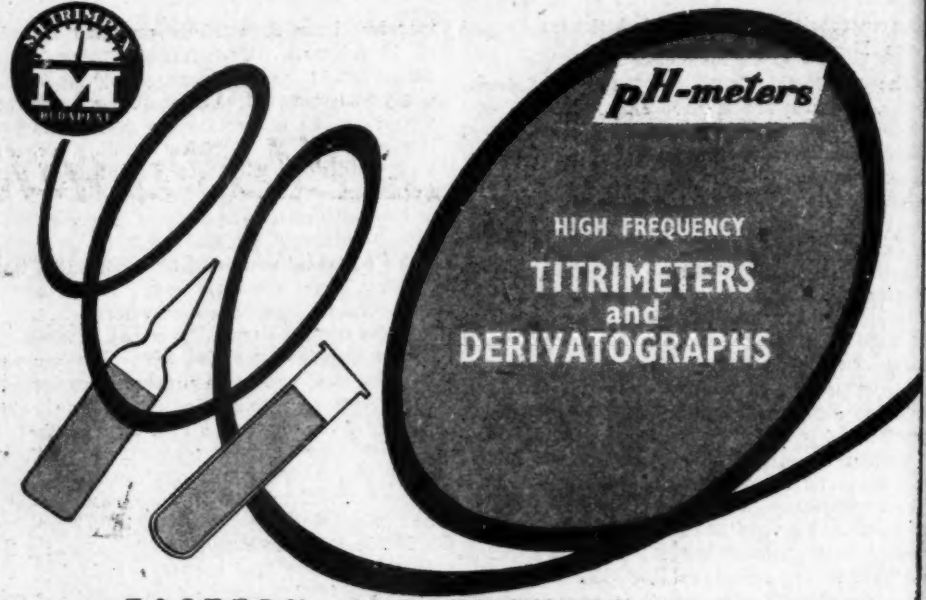
Since the cost of refrigerating the whole transformer would be excessive, only the superconducting coils themselves are cooled, while the cores are kept at room temperature. Heat leaks into the system are controlled by vacuum insulation, liquid-nitrogen heat shields, and an ingenious arrangement of the superconducting input leads.—(*J. Frank. Inst.*, 1961, 272, 245.)

913-61. Printed at The Bangalore Press, Bangalore City, by T. K. Balakrishnan, Superintendent, and Published by A. V. Telang, M.A., for the Current Science Association, Bangalore.

All material intended for publication and books for review should be addressed to the Editor, *Current Science*, Raman Research Institute, Bangalore-6.

Business correspondence, remittances, subscriptions, advertisements, exchange journals, etc., should be addressed to the Manager, Current Science Association, Bangalore-6.

Subscription Rates: India: Rs. 12-00. Foreign: Rs. 16-00; £ 1-4-0; $ 4.00.



Agents :— **EASTERN ELECTRONICS, FARIDABAD**

'STANDARD' RHEOSTATS

SINGLE, DOUBLE & FOUR-TUBE

COVER A WIDE RANGE
FOR USE IN
LABORATORIES & WORKSHOPS

Made by:

THE STANDARD SCIENTIFIC INSTRUMENTS CO.
115, BRODIES ROAD, MADRAS 28

SPECTROSCOPIC EQUIPMENT
AND
ACCESSORIES
FOR
QUANTITATIVE ANALYSIS & RESEARCH WORK

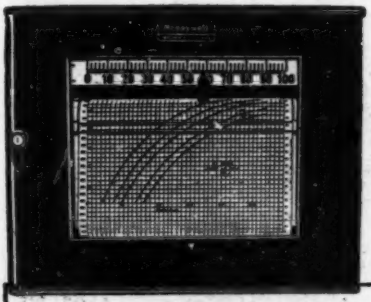
Light sources like Arc Lamps with universal movements, precision slits, mountings for spectrographs, cameras, microphotometers, etc., etc.

Entirely Our Manufacture

For full particulars, please write to :

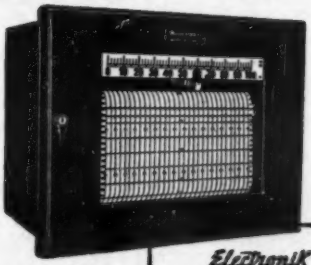
THE GENERAL ENGINEERING AND SCIENTIFIC CO.
WALTAIR, VISAKHAPATNAM-3
(S. INDIA)
GRAMS : "ELECTRONIC"
Technical Adviser:
Dr. L RAMAKRISHNA RAO
M.A., PH.D. (CAL.)., D.SC. (LOND.)

Measure and plot changes in variables as they occur... with ElectroniK instruments for research



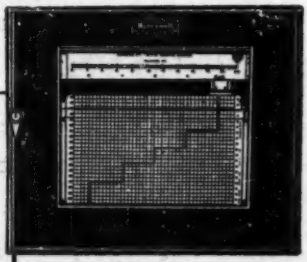
ElectroniK

FUNCTION PLOTTER Automatically and continuously plots a curve which shows the relationship of one variable to another. Typical uses: speed versus torque, stress versus strain, temperature versus pressure, plate voltage versus plate current (and other electron tube characteristics), and many other variable relationships.



ElectroniK

NARROW SPAN RECORDERS Accurately measure d-c potentials as low as 0.1 microvolt and spans as narrow as 100 microvolts. Available as a precision indicator, circular chart recorder, and strip chart recorder. Useful (with appropriate primary measuring elements) for measuring differential temperatures and slight variations in the temperatures of small objects through the use of radiation pyrometry.



ElectroniK

EXTENDED RANGE RECORDER Facilitates measurement of any linear variable whose values change over a wide range, and where precise evaluation and good resolution are important. This instrument is particularly suited to the measurement of forces in conjunction with a strain gage bridge.

Here's an exceptional group of instruments to measure and record your research findings swiftly, surely, conveniently. These ElectroniK instruments for research can speed completion of your projects, by eliminating many of the tedious, time-consuming details of test work.

ElectroniK

ADJUSTABLE SPAN RECORDER Measures spans and magnitudes of a variety of emf's. Instrument calibration can be in terms of any variable reducible to d-c voltage. Can be used with thermocouples, steam gages, tachometers, and other transducers.

PEBS-64 A

H Honeywell

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

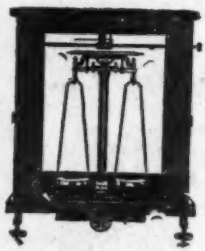
Contact

BLUE STAR

BLUE STAR ENGINEERING CO. (Bombay) Private LTD.

SUKH SAGAR
SANDHURST BRIDGE, BOMBAY 7
TELEPHONE: 41334

Also at CALCUTTA DELHI, MADRAS JAMSHEDPUR



KEROY

Short Beam Analytical Balance

No. K 5

A Popular Model Students Balance for College Laboratories

Sensitiveness	..	1/10th mg.
Capacity	..	200 gm.
Price	..	Rs. 225

Catalogue on Request

Manufactured by:

Keroy (Private) Ltd.

BANARAS CANTT. :: CALCUTTA 10

Tele.: {3282 Res. 3346

Phone: 24-3840

Potassium Chromate

(Analytical Reagent)

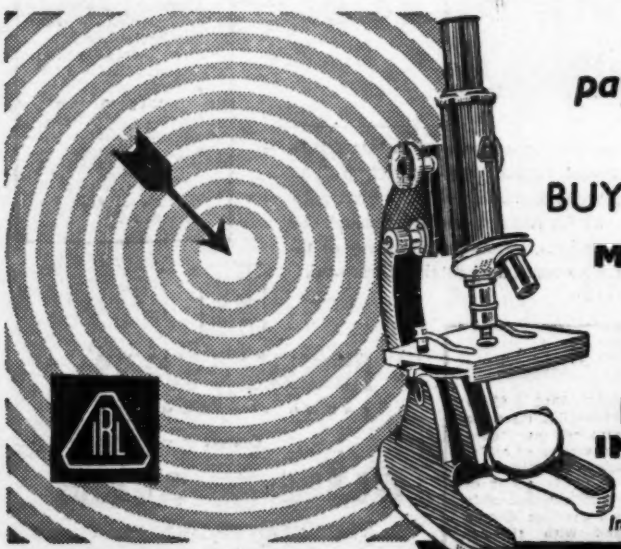
Max. Limit of Impurities

Chloride.....	0·001%
Sulphate.....—....	0·02%
Calcium.....-	0·005%

THE INTERNATIONAL CHEMICAL INDUSTRIES

103-B, UPPER CIRCULAR ROAD

CALCUTTA-9!



pay for precision

BUY IRL PRODUCTS

MICROSCOPES and PRECISION OPTICAL MEASURING INSTRUMENTS

India's Leading Manufacturers

Sole Selling Agents

MERCANTILE UNION PRIVATE LTD.

309, Bepin Behary Ganguly Street, Calcutta 12

Phone : 22-5778

INSTRUMENT RESEARCH LABORATORY LTD. CALCUTTA.

NA IRL-342

The NEW **Perkin-Elmer**
Model 221 Infrared Spectrophotometer

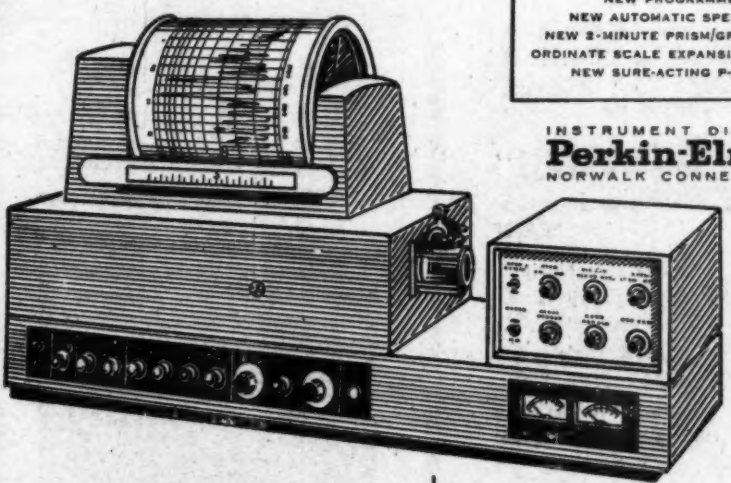
gives every spectroscopic laboratory the finest in accuracy, ease and versatility of infrared analysis

The powerful Model 221 is the newest in Perkin-Elmer's line of infrared spectrophotometers—the most widely used instruments of their kind in the spectroscopic laboratories of the world.

Designed for convenience and speed in operation previously not available in quality I. R. spectrophotometers, the Model 221 combines wide versatility with high resolution and accuracy. In speed of analysis, in number of analyses per day, in first-time accuracy of determinations—the Model 221 is ready to bring a totally new dimension of infrared analysis to your laboratory, give you more useful information—faster.

Many special attachments are available for use with the Model 221 to extend its enormous versatility. Perkin-Elmer engineers are always adding to the list of available accessories as new problems arise or as new techniques are discovered.

Features of the Model 221 include:
NEW AUTOMATIC GAIN CONTROL
NEW PROGRAMMED SCANNING
NEW AUTOMATIC SPEED SUPPRESSION
NEW 2-MINUTE PRISM/GRATING INTERCHANGE
ORDINATE SCALE EXPANSION AND COMPRESSION
NEW SURE-ACTING P-E RECORDER PEN



INSTRUMENT DIVISION
Perkin-Elmer *Corporation*
NORWALK CONNECTICUT

Sold and serviced in India exclusively by

BLUE STAR

BLUE STAR ENGINEERING CO. (Bombay) Private LTD.
LOTUS COURT
JAMSHEDJI TATA ROAD, BOMBAY 1
Also at CALCUTTA · DELHI · MADRAS

PEBS-PE 46/60

Sigcol

LABORATORY
GLASS APPARATUS

卐

Sole Selling Agents:

GHARPURE & CO.

P-36, ROYAL EXCHANGE PLACE EXTN.
CALCUTTA 1

Gram: "MEENAMO" Phone: 22-2061

FOR
ACCURACY
AND
DEPENDABILITY
in
CHEMICAL ANALYSIS & RESEARCH
use
laboratory reagents and guaranteed reagents

Manufactured by

SARABHAI MERCK LIMITED

In conjunction with E. MERCK A.G. Darmstadt, Germany
Sarabhai Merck Limited · 13 Wittet Road, Bombay 1

shilpi-s.m. 201

VERY RELIABLE INDIGENOUS SUBSTITUTES
OF GUARANTEED ANALYTICAL REAGENTS
MAY BE FOUND IN

"BASYNTH"
Brand
ANALYTICAL REAGENT

Acid Hydrochloric
Acid Hydrochloric Fuming
Acid Sulphuric
Acid Nitric
Acid Nitric Fuming
Acid Acetic Glacial
Ammonium Hydroxide
Benzene
Toluene
Xylene
Petroleum Ether
Amyl Alcohol
Butyl Alcohol Etc., Etc.

Basic & Synthetic Chemicals (Private) Ltd.
P. O. Jadavpur University, Calcutta-32

MADE IN INDIA
HIGH VACUUM
ROTARY PUMP
SINGLE STAGE & TWO STAGE
with or without Air Ballast
All Indian materials and construction

BASIC & SYNTHETIC CHEMICALS
(PRIVATE) LTD.
P.O. Jadavpur University, CALCUTTA 32

For

ZOOLOGICAL SPECIMENS
REQUIRED BY
LABORATORIES
AND
INSTITUTIONS

Consult:

Bombay Biological House

Dealers in Zoological Specimens

119, Hindu Colony, Dadar, Bombay 14

Established 1941

Phone : 61813 Gram : PHERETIMA

KINDLY CONTACT US:

- Physics Instruments.
- Laboratory Glassware and Thermometers.
- Laboratory Porcelainware and Silicaware.
- Balances, Analytical, Physical and Chemical.
- Student's Microscopes and all other requirements for Biology Department.
- Ovens, Incubators, Centrifuges, etc.
- Laboratory Chemicals.
- Movie Projectors, Slide/Filmstrip Projectors, Epidiascopes, Public Address System, Tape Recorders and Cameras for Research Work.

M/s. INDSALES Corporation

11, HORNIMAN CIRCLE
BOMBAY-1

Phone : 253264 Grams : 'ANALYTICAL'

BOROSIL

LABORATORY GLASSWARE

such as

FLASKS, BEAKERS, CONDENSERS, MEASURING FLASKS, MEASURING CYLINDERS, PIPETTES & ANY SPECIAL APPARATUS MADE TO DESIGN

and

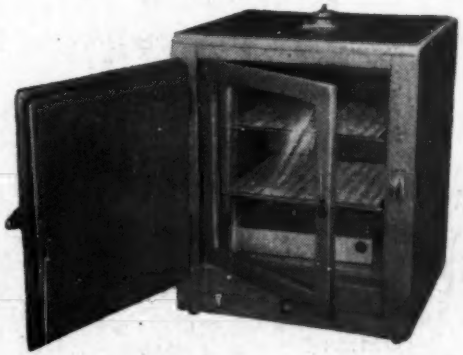
PENICILLIN VIALS, VACCINE BULBS—WHITE & AMBER

ALL OTHER APPARATUS & EQUIPMENT MANUFACTURED TO CLIENT'S DESIGN

INDUSTRIAL & ENGINEERING APPARATUS CO. (PRIVATE) LTD.

CHOTANI ESTATES, PROCTOR ROAD
GRANT ROAD, BOMBAY 7

TEMPO LABORATORY EQUIPMENT

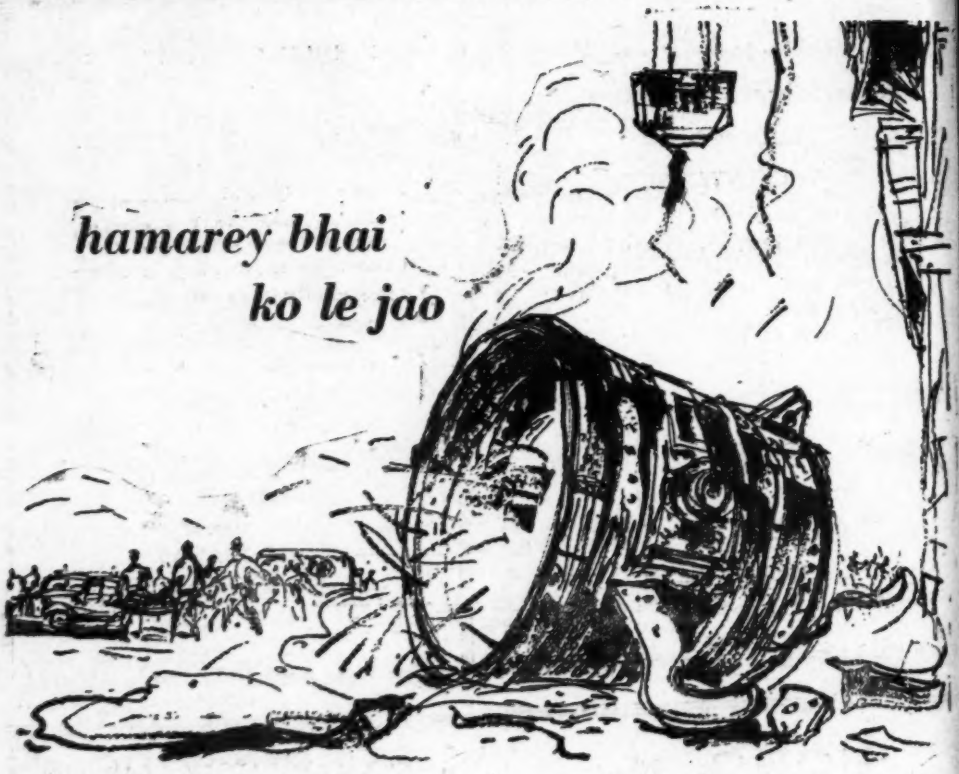


(INCUBATOR Bacteriological)

TEMPO INDUSTRIAL CORPORATION (PRIVATE) LTD.

Senary Road, Paranjpe 'B' Scheme, BOMBAY-57

hamarey bhai ko le jao



It happened some years ago in the steel melting shops at the Jamshedpur works. A large ladle, carrying 75 tons of molten iron, suddenly crashed to the ground with a deafening noise from an overhead crane. The spattering sparks and red-hot metal seriously injured a number of brick-layers working at what seemed to be a safe distance. The air was rent with the frenzied shouts of the men and the hissing of steam.

The first ambulance could remove only five of the injured to the hospital. General Manager Keenan could take only three more in his car. He chose the three who had a better chance of survival than the rest. One of these men, a Hindu worker, however, refused to go. "Do not take me away", he said. Disregarding his own agony, he feebly nodded towards a half-burnt Muslim colleague, and said: "*Hamarey bhai ko le jao.*" As Keenan recalls, "The Hindu who was in pain and danger of death remembered, not that the Mohammedan was of a different faith, but that he was his brother."

This feeling of comradeship, born of the common bond of labour, is the spirit that characterises Jamshedpur, where industry is not merely a source of livelihood but a way of life.

JAMSHEDPUR

THE STEEL CITY

The Tata Iron and Steel Company Limited

JWTTN 5350A

INJECTABLES — Safe and Dependable

TRADE MARK

A wide range of parenteral preparations for meeting the growing requirements of the Medical Profession are now being processed in our Laboratories. They are made from Standard Chemicals employing double distilled and PYROGEN FREE water. Their containers (Ampoules) undergo rigid neutrality tests before they are selected for use. These Injectables are therefore guaranteed to be absolutely safe and dependable.

The following are but a few of our well-known Injectables :

- RETICULIN .. .. .. A Potent extract of Liver
- HEXOPURIN .. .. .. An urinary Antiseptic
- CALCITOL .. .. .. Injectable Calcium Gluconate
- BEVITAMIN .. .. .. „ Vitamin B_1
- CEVITAMIN .. .. .. „ Vitamin C
- GLUCOSE SOLN. .. .. .. „ Pure Dextrose

The Mysore Industrial & Testing Laboratory Ltd.

Malleswaram P.O., Bangalore 3

Bengal Chemical and Pharmaceutical Works, Ltd.

The Largest Chemical Works in India

Manufacturers of Pharmaceutical Drugs, Indigenous Medicines, Perfumery, Toilet and Medicinal Soaps, Surgical Dressings, Sera and Vaccines, Disinfectants, Tar Products, Road Dressing Materials, etc.

Ether, **Mineral Acids, Ammonia, Alum, Ferro-Alum, Aluminium Sulphate, Sulphate of Magnesium, Ferri Sulph., Caffeine and various other Pharmaceutical and Research Chemicals.**

Surgical sterilizers, Distilled Water Stills, Operation Tables, Instrument Cabinets and other Hospital Accessories.

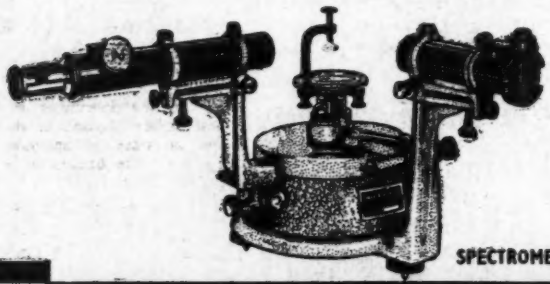
Chemical Balance, Scientific Apparatus for Laboratories and Schools and Colleges, Gas and Water Cocks for Laboratory use, Gas Plants, Laboratory Furniture and Fittings.

Fire Extinguishers, Printing Inks.

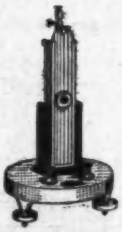
Office: **6, GANESH CHUNDER AVENUE, CALCUTTA-13**

Factories: **CALCUTTA - BOMBAY - KANPUR**

Precision built... for laboratories...



SPECTROMETERS



GALVANOMETERS

POTENTIOMETERS

Film Strip and Slide PROJECTORS

KAYCEE Scientific Instruments

Quality-tested at every stage of their manufacture, these KAYCEE precision-built scientific instruments for laboratory use can be depended upon for accurate, long-lasting, trouble-free service.

We also make Lamp & Scales, Telescope & Scales, Resistance Boxes, Travelling Microscopes and Ammeters, Voltmeters, Students' Galvanometers, etc.

Bajaj Electricals Limited

(Formerly RADIO LAMP WORKS LTD.)

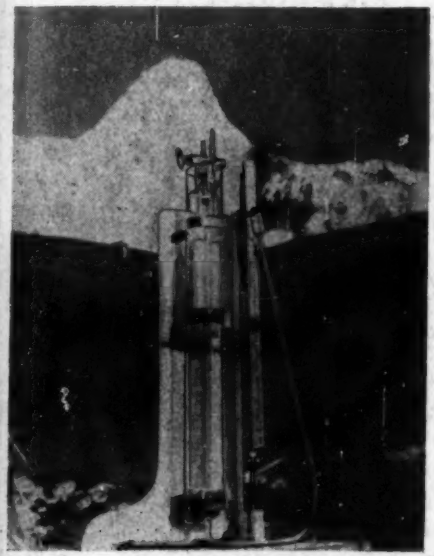
Bombay • Calcutta • New Delhi • Madras
Kanpur • Patna • Indore • Wardha • Gauhati

bares'-BE-29 A

LLOYD GAS ANALYSIS APPARATUS

BRITISH PATENT 844905, U.S. PATENT 2972523, INDIAN PATENT.... 67406, GERMAN PATENT L33087 AND OTHER PATENTS PENDING....

* **Rapid O_2 and CO_2 determinations**
* **No tedious adjustments**
* **Light and portable**
* **Fully compensated for changes of temperature and pressure**
* **Precision about 0·02% of total volume**
* **No joints to leak**



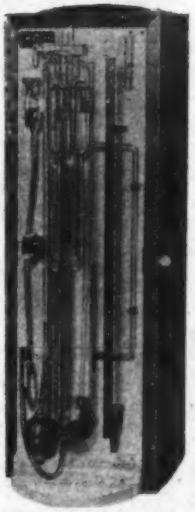
One of the original Lloyd gas analysis apparatus used by the Himalayan Scientific and Mountaineering Expedition 1960/61

For the determination, in less than six minutes, of oxygen and carbon dioxide in air respiratory gases, flue gases, etc. The accuracy of analysis is approximately 0·02% of total volume. The apparatus is self-compensating for temperature and pressure changes and results are obtained directly from the burette readings. The main part consists of one unit of glassware, with a special five-way stopcock, through which the samples are admitted, passed to the absorbents and finally expelled.

It is easily charged with reagents; easily maintained, serviced and cleaned, and may be stored in its own carrying case indefinitely without danger of leakage or exhaustion of absorbents. Because the apparatus dispenses with the dummy burette, the movable potash reservoir and the third meniscus mark of the traditional Handane apparatus it is very much quicker and simpler to use than the Haldane. Analysis for CO_2 and O_2 may be made on six samples in half an hour. The compact design restricts the dead spaces over the absorbents and so promotes rapid absorption.

Gallenkamp hold the sole licence to manufacture and sell, as well as to use the name Lloyd in connection with this gas analysis apparatus.

ASK FOR DETAILS



Gallenkamp

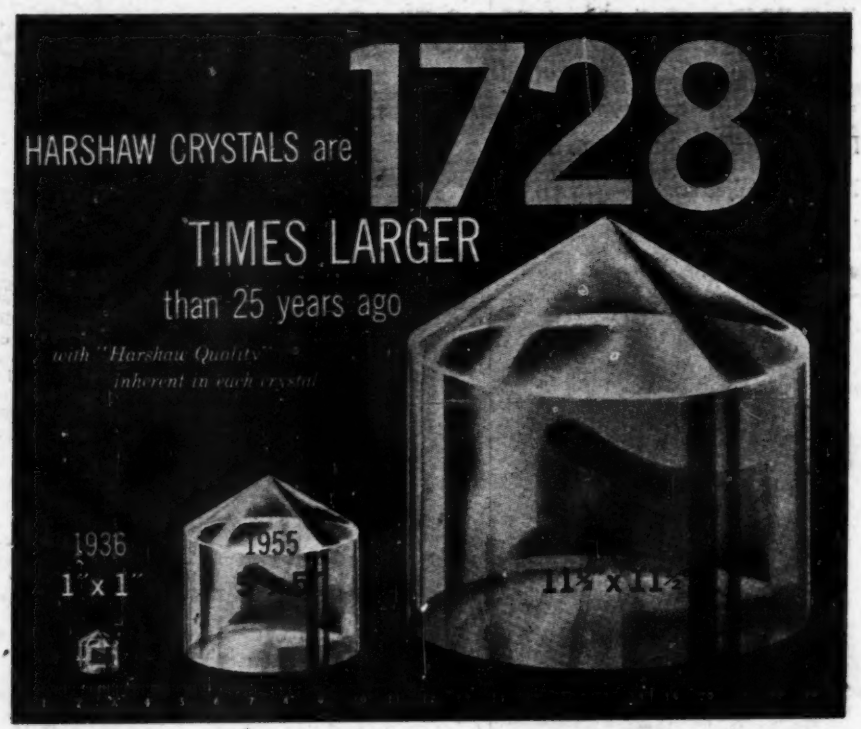
A. GALLENKAMP & CO. LTD., TECHNICO HOUSE, [SUN STREET, LONDON E.C. 2

Accredited Agents in India

MARTIN & HARRIS (Private) LTD.

(SCIENTIFIC DIVISION)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1



This year Harshaw's Crystal Division celebrates its Silver Anniversary. In these 25 years the "art" of growing crystals has given way to scientific procedures. With expanded crystal research and development laboratories, and recently doubled production facilities, Harshaw, stands ready to produce your crystals—regardless of technical nature or production magnitude. Their physics, chemistry, and engineering departments enjoy the challenge of increasingly stringent demands from scientists and instrument manufacturers for infra-red and ultra-violet optical crystals, and scintillation phosphors.

OPTICAL CRYSTALS

For Infra-red and Ultra-violet Transmitting Optics

* Sodium Chloride
* Sodium Chloride Monochromator Plates
* Potassium Bromide
* Potassium Bromide Pellet Powder (through 200 on 325 mesh)
* Potassium Chloride
* Optical Silver Chloride
* Thallium Bromide Iodide
* Lithium Fluoride
* Lithium Fluoride Monochromator Plates
* Calcium Fluoride
* Barium Fluoride
* Cesium Bromide
* Cesium Iodide

SCINTILLATION

Mounted NaI (Tl) Crystals

Crystal detectors designed for your most sophisticated counting problems. Their physics and engineering groups are available to assist you.

* Other Phosphors—Rough Cut Thallium Activated Sodium Iodide Crystal Blanks
* Europium Activated Lithium Iodide (Normal)
* Europium Activated Lithium Iodide (96% Li^6 Enriched)
* Thallium Activated Cesium Iodide
* Thallium Activated Potassium Iodide
* Anthracene
* Plastic Phosphors

Write for 36-page booklet "Synthetic Optical Crystals" or 44-page booklet "Scintillation Phosphors"

Sole Distributors:

THE SCIENTIFIC INSTRUMENT COMPANY LTD.

ALLAHABAD, BOMBAY, CALCUTTA, MADRAS, NEW DELHI

SIC 1911–1961

N
tals
gned
cated
phy-
s are
n Cut
dium
hium
hium
ned)
esium
ssium
61

A. A.
Achar
Agarv
Agarv
Aghor
Agnih
Agnih
Ahuja
A. J.
Anant
Ansar
Ansel
A. R.
A. S.

Atal,
Atwal
Aziz K

Babu,
Babu,
Babu
Babu,
Badka
Balakr
Balakr
Balara
Balasu
Banerj
Banerj
Basu,
Baxi,
Baxi,
Bedi, S
Bhagir
Bhanda
Bharati
Bharuc
Bhaska
Bhatia,
Bhatia,
Bhat, J
Bhatna
Bhatna

Current Science, Vol. XXX, 1961

Author Index

	Page
A. A. K. (*Rev.*)	118
Achan, P. D.	265
Agarwala, S. C.	427
Agarwala, V. S.	12
Aghoramurthy, K.	213
Agnihotri, J. P.	65
Agnihothrudu, V.	24
Ahuja, L. R.	473
A. J. (*Rev.*)	34, 355
Anantharaman, T. R.	379
Ansari, M. N. A.	193
Anselm Austin	24
A. R. V. (*Rev.*)	73
A. S. G. (*Rev.*)	119, 157, 159, 275, 315, 355, 396, 439, 480, 483
Atal, C. K.	177, 338
Atwal, A. S.	435
Aziz Khan, A.	141
Babu, C. N.	113
Babu, D. R. C.	417
Babu Rao, P.	332
Babu, S. K.	19, 384
Badkas, D. J. (*Rev.*)	356
Balakrishnan, V.	16
Balakrishna, S.	183, 264, 410
Balaram Sahoo	293, 380
Balasubramanian, M.	149
Banerjee, D. K. (*Rev.*)	120, 356
Banerjee, S. P.	330
Basu, A. N.	390
Baxi, A. J.	16
Baxi, K. K.	267
Bedi, S. J.	191, 403
Bhagiratha Rao, E.	9
Bhandari, M. M.	154
Bharati Mehra	308
Bharucha, F. R.	67
Bhaskar Rao, H. V.	221
Bhatia, D. S.	381
Bhatia, S. K.	327
Bhat, J. V.	382
Bhatnagar, C. S.	11
Bhatnagar, G.	304
Bhatnagar, G. C.	110
Bhatnagar, M. P.	271, 477
Bhatnagar, P. L. (*Rev.*)	117, 314
Bhatnagar, S. S.	420
Bhat, N. R.	425
Bhattacharjee, P. N.	103, 181
Bhattacharya, A. K.	380
Bhattacharya, Arun K.	14
Bhatt, M. V. (*Rev.*)	438
Bhatt, V. P.	293
Bhavsar, C. M.	51
Bheemasankara Rao, Ch.	259, 333, 414
Bilgrami, K. S.	343, 348
Bose, S. R.	307
Boszormenyi, Z.	102
Brahm Dev	457
Broadbridge, E. S.	290
B. R. S.	364
B. S. T. (*Rev.*)	35, 241
Capoor, S. P.	353
Cecily (Miss) P. J.	319
Chacko, M. J.	69, 73
Chakravarty, R.	428
Chakravarty, S. C.	224
Chakravartti, M. R.	463
Chandrasekhariah, M. S.	336
Chandrasekhariah, S. R.	392, 476
Chandratreya, P. V.	137
Channa Basavanna, G. P.	111, 114
Chatterji, A. K.	75
Chatterji, S.	104, 105, 230, 391
Chaturvedi, S. K.	112
Chauhan, L. S.	273
Chavan, A. R.	191, 403
Chiplonkar, V. T.	98
Chiranjivi Rao, K.	113
Chopra, I. C.	223
Chopra, S. L.	203
Choughuley, A. S. U.	99
Cseh, E.	102
Dabholkar, M. V.	39
Das, B. C.	303

	Page
Dasgupta, J.	150
Das Gupta, S. N.	450
Das, M. R.	370
Das, S. R.	138
Das, U. K.	386
Datar, M. G.	455, 456
Datta, S. N.	182
Daya Bhanu	420
Dekate, Y. G.	263
Deoras, P. J.	465
Deshpande (Miss) U. P.	21
Deshpande, V. T.	377
Desikachar, H. S. R.	261, 337
Dhanda, M. R.	228
Dhande, G. W.	351
Dharampal Singh	27, 62
Dhareshwar, B. V.	336
Dhatt, M. S.	179
Dhawan, C. L.	107
Dhawan, N. L.	109, 233
Dias, F. F.	382
Dmitruk, A. P.	448
Dutta, S. N.	53
Dutt, S.	104
Dwivedi, J. N.	342
Edith Cseh	102
Eswaran, K. S. S.	352
Ethirajan, A. S.	350
Fernandes, F.	420
Ganapati, P. N.	61, 225, 464
Ganapathy, P. S.	190
Gandhi, S. M.	271
Ganesan, A. S.	285
Ganguly, P.	300
Gangwar, B. M.	319
Garga, R. P.	345
Gautam, O. P.	473
George, M. G.	268
Ghosh, R. B.	73
Ghosh, R. N.	69
Gonzalves, Ella A.	143
Gopala Aiyar, K. V.	113
Gopalakrishnan, K.	257
Gopal Swarup	360
Govekar, G. M.	263
Govil, G.	252, 331
Govindan Nayar, K. N.	228
Goyal, S. K.	154
Grigoryan, A. T.	247
Guglani, P. L.	109
Guha, S. R. D.	143
Gupta, P. K.	10
Habbu, M. K.	263
Haldane, J. B. S.	214
Haldane, J. B. S. (*Rev.*)	239
Handoo, O. N.	31
Hanumantha Rao, K.	303
Hardas, M. W.	109
Herwald, S. W.	207
H. S. R. (*Rev.*)	80
Ian Fells	323
I. H. (*Rev.*)	482
Islam, A. S.	433
Iswaran, V.	182, 261
Iyer, R. D.	67
Iyer, V.	145
Iyengar, N. K. (*Rev.*)	200
Iyengar, R. L. N. (*Rev.*)	200
Jacob, S. C.	384
Jadhav (Miss), Kamal A.	144
Jagathesan, D.	155
Jain, B. D.	457
Jain, J. S.	360
Jain, S. K.	262
Jain, S. P.	341
Jai Prakash Narain, R. K.	305
Jambor, B.	102
Janardana Sarma, T.	296
Jijie, K.	258
Joginder Singh	109, 233
Johnson, P. V.	183
Jones, F. G. W.	187
Joshee, A. K.	465
Joshi, A. B.	109, 393
Joshi, P. V.	422
Jugal Kishore	257
J. V. B. (*Rev.*)	441
Kachhawaha, M. S.	14
Kadkol, S. B.	337
Kailasam, L. N.	168
Kalani (Miss), I. K.	312
Kalke, J. R.	460
Kamal Mohnot	427
Kamat, D. N.	422
Kamat, V. N.	420
Kameswara Rao, B. V.	108
Kameswara Rao, K.	182
Kandasami, P. A.	188
Kanekar, C. R.	7, 252, 331
Kanwar, J. S.	203
Kapoor, B. M.	72, 476
Kapoor, J. N.	308
Kapur, O. P.	298
Kapur, S. L. (*Rev.*)	398

	Page
Karamchandani, S. J.	373
Karezmarz, K.	313
Karibasappa, B. K.	432
Kartha, K. N.	221
Kashikar, M. D.	142
Kashyap, R. L.	366
Katiyar, S. S.	175
Kaul, K. N.	131
Kaur, S.	298
Kessar, S. V.	414
Khanolkar, D. D.	52
Khanolkar, V. R. (*Rev.*)	238, 276, 431
Khanwilkar, V. G.	31
Khetrapal, C. L.	252, 331
Khoshoo, T. N.	327
Kishan Singh	63
Kishen, K.	407
Knypl, J. S.	264, 443
Kohli, R. C.	340
Krishnamurti, B. G.	383
Krishnamurty, K. G.	287
Krishnamurty, K. V.	467
Krishnan, A. A. (*Rev.*)	397
Krishnan, R.	306, 435
Krishnaswami, S.	152, 353
K. R. (*Rev.*)	81, 121, 201, 280, 441
K. S. V. (*Rev.*)	157, 275, 314, 437, 479
Kukla, A. S.	218
Kulkarni, A. B.	101, 142
Kuriyan, G. K.	319
Kushwaha, K. S.	229, 266
K. V. (*Rev.*)	275, 438
Lakshmana Rao, M. V.	461
Lakshmi Bai, C.	134, 366
Lakshminarayanaiah, N.	13, 258
— (*Rev.*)	397
Lal, S. B.	273
Leelanandam, Ch.	20, 115
Lekshmy, A.	388
Lewis, E. J.	143
Lewis, Y. S.	381
Lingaraj, D. S.	392
Madan, T. N. (*Rev.*)	37, 82
Madhavi, R.	303
Magoon, M. L.	347
Mahajan, K. P.	414
Malhotra, C. L.	296
Malik, Wahid U.	141
Maneck, S. S.	98
Mankad, B. N.	335
Manohar, H.	5
Marimuthammal, S.	22
Mathur, A. C.	223
Mathur, B. N.	477
Mathur, P. N.	354
Mathur, R. L.	65
Mathur, R. S.	203, 272, 307, 312, 360
Mathur, S. L.	471
Mecke, R.	43
Mehdiratta, R. C.	147
Mehra, B.	308
Mehta, C. M.	15
Mehta, C. R.	460
Merchant, J. R.	99
Merchant, R. N.	455
Mhatre, H. K.	263
Mirashi, M. V.	430
Mir Hamid Ali	486
Misra, A. P.	189
Misra, J. S.	262
Misra, M. P.	272, 307, 360
Misra, R. C.	163
Misra, R. N.	70
Misra, U. S.	31
Mitra, G. C.	131
Mitra, G. N.	395
M. K. S. (*Rev.*)	242
Mohnot, K.	427
Mookherji, A.	217
M. R. A. (*Rev.*)	34, 78
M. R. S. (*Rev.*)	201, 280
M. S. K. (*Rev.*)	440
Mukherjee, D. P.	138, 433
Mukerji, K. G.	231, 345
Mukundan, M. A.	461
Munjal, R. L.	308
Munshi, A. A.	219
Murty, B. R.	467
Murty, G. S.	467
Murty, M. S.	295
Nagarajan, G.	377, 413
Naha, P. M.	417, 462
Nair, N. R.	474
Narasimhan, K. C.	139
Narasimha Murthy, D. P. (*Rev.*)	481
Narayanamurti, D.	340
Narayanan, S.	145
Natarajan, B. V.	188
Nayak, V. N.	223
Nayar, K. K.	363
Nedungadi, T. M. B.	416
Neelakantan, S.	90, 381
Neogy, D.	217
Nirula, K. K.	319
Norrish, R. G. W.	405

	Page
Pandhye, A. A.	180
Padmanabhan, D.	424
Paharia, K. D.	354
Pai, R. M.	274
Pal, A.	300
Paliwal, G. S.	269
Pande, P. G.	59, 147, 267, 299
Pandey, I. C.	312
Pandya, N. S.	293
Panje, R. R.	211
Pant, D. D.	308
Pant, P. C.	143
Paradkar, S. A.	430
Parameswaran, N.	344
Parameswaran, S.	39
Parameswar, N. S.	476
Parthasarathy, M. R.	333
Patel, B. D.	393
Patel, G. H.	15
Patel, K. A.	234
Patel, K. S.	335
Patel, N. J.	51
Pathak, G. N.	434
Pathki, K. G.	379
Patil, B. V.	155
Patnaik, D.	54, 293, 380
Perur, N. G.	58
Phatak, D. M.	101
Pillai, C. K. C. S.	430
Pillai, V. K.	388
Plyler, Earle K.	1
Prasad, A. B.	30
Prasad, A. R.	193
Prasad, M. R. N. (*Rev.*)	317
Prasad, N.	65, 110
Prakash, P.	228
Prakash, Sarup	230
Priti Awasthi (Miss)	469
Pujari, S. K.	380
Purkayastha, B. K.	152
Puri, V. (*Rev.*)	442
Purna Chandra	325
Purohit, M. L.	31
Pushkarnath (*Rev.*)	399
Puttarudriah, M.	114
— (*Rev.*)	358
Qaiyum, F.	433
Rachie, K. O.	107
Racine, C. (*Rev.*)	117, 198, 437, 479
Radhakrishnamurty, R.	261
Raghavan, R. S.	310
Raghavarao, K. V.	329
Raghava Rao, M.	264
Rahalkar, G. W.	105, 391
Raheja, P. C. (*Rev.*)	279
Rai, J. N.	231, 345
Raizada, M. B. (*Rev.*)	400
Rajagopalan, K.	145, 257
Rajagopalan, N.	222
Rajagopalan, S. R.	459
Raja Rao, B.	226
Raja Rao, T.	211
Raju, T. S.	329
Ramachandra Iyer, P. K.	147, 299
Ramachandran, G. N.	127
Ramachandran, K.	194
Ramachandra Rao, B.	9
Ramachandra Rao, S.	188
Ramaiah, A.	219
Ramaiah, N. A.	175
Ramakrishnan, Alladi (*Rev.*)	33
Ramakrishnan, K.	431
Ramakrishnan, S.	416
Ramana Rao, B. V.	305
Ramana Rao, D. V.	259
Ramanna, M. S.	347
Rama Rao, P.	379
Ramaseshan, S.	5
Ramaswami Ayyar, P. (*Rev.*)	316
Ramaswamy, M. S.	17
Rampal, A. L.	414
Ram Udar	22
Randhawa, H. S.	224
Ranganathan, S. R. (*Rev.*)	201, 442
Ranga Rao, D. R.	232
Rangaswami, G.	25, 64, 149, 352
Rao, A. N.	426
Rao, C. N. R. (*Rev.*)	199, 356
Rao, J. T.	349
Rao, L. N.	388
Rao, P. N.	433
Rao, R. S.	244
Rao, V. S. R.	453
Reddy, D. B.	192
Renga Ayyar, G.	29
Richharia, R. H.	30, 189
Rishi, A. K.	182, 261
Rolla, S. R.	310
Roy, B. B.	106
Roy, J. K.	30
Roy, R. P.	26
Sabnis, S. D.	191, 403
Sadasivan, T. S.	45
— (*Rev.*)	278
Sahadevan, P. C.	325, 474
Saksena, S. D.	31
Sandhu (Mrs.), D. K.	224
Sandhu, R. S.	224

	Page
Sanghvi, L. D.	16
Saraswathy Royan	148
Sarma, P. S. (*Rev.*)	35, 238, 277, 316, 357
Sasisekharan, V.	127
Sastry, A. S.	108
Sathyanesan, A. G.	302
Satish Chandra	22
Satyanarayana Rao, V. R.	176
Saxena, G. P.	140
Saxena, H. B.	56
Saxena, P. N.	105, 391
Saxena, R. S.	140
Sekariah, P. C.	59, 147, 228, 267, 299
Sen, A. C.	466
Sen Gupta, S. K.	307
Sen, N. K.	303, 435
Seshadri, T. R.	90, 218, 287, 333
Seshu, D. V.	189
Sethi, G. R.	105, 391
Sethi, J. K.	177, 338
Shah, G. Z.	215
Shah, N. B.	460
Shah, P. R.	415
Shah, S. M.	455
Shambulingappa, K. G	347
Shankar, J. V.	67
Shanmugasundaram, E. R. B.	219, 461
Shanthakumari, K.	223
Sharma, A. K.	75
Sharma, C. P.	427
Sharma, J. C.	266
Sharma, L. S.	266
Shastry, S. V. S.	70, 232
Shekhawat, G. S.	477
Shivaramiah, G.	190
Shrivastava, B. P.	262
Shukla, R. R.	59, 147, 267, 299
Siddiqui, Z. A.	193
Singh, D.	12, 137
Singh, K.	54
Singh, K. P.	434
Singh, P. P.	297, 462
Singh, S. N.	62
Singh, S. I.	297
Singh, T. P.	302
Singh, V. P.	63
Sinha, R. P.	26
Sinha, U.	30
Sircar, S. M.	428
Sirsi, M. (*Rev.*)	37, 79, 122, 241, 279, 317
Sitaramachandramurthy, A.	336
Sneh Lata Mathur	471
Solomon Raju, N.	61
Sonalkar, V. G.	456
S. P. (*Rev.*)	158, 197, 198, 236
Sreedhara Murthy, N.	216
Sreerama Murty, K.	332
Sreeramulu, C.	188
Sreenivasaya, M.	417
Srimathi, R. A.	417
Srinivasagam, R. T.	196
Srinivasan, K. V.	425
Srinivasan, V.	415
Srinivasan, V. V.	185, 353
Srivastava, J. B.	223
Subba Rao, B. C.	218
Subba Rao, B. R.	69
Subba Rao, K. S.	188
Subba Rao, M. N. (*Rev.*)	160, 439
Subbiah, B. V.	180
Subramanyam, S. V.	454
Subrahmanyan, R.	289
— (*Rev.*)	36, 240, 440
Subrahmanyan, V.	13, 261
Subramaniam, M. K.	172
— (*Rev.*)	120, 161, 202
Subramanyam, S.	172
Subramaniam, C. P.	431
Subramanian, C. V.	423
— (*Rev.*)	79, 481
Sulaiman, M.	351
Sulbha, K.	67
Sundararajan, S.	139
Sundaram, T. K.	461
Sur, B. K.	56, 297, 462
Suryanarayana, D.	114
S. V. C. (*Rev.*)	159, 480
Swaminathan, K.	319, 418
Swaminathan, M. (*Rev.*)	120, 241
Swaminathan, M. S.	67, 155
Swamy, B. G. L.	424
Talukdar, J. N.	28, 274
Tandan, P. C.	162
Tandon, R. N.	343, 348
Tandon, S. L.	72, 476
Tawde, N. R.	137, 216
Tewari, B. S.	360
Tewari, J. P.	231
Teaotia, S. S.	312
Thaker, B. M.	215
Thapliyal, J. P.	304
Thirumalachar, M. J.	180
Tontadarya, T. S.	111
Tiagi, B.	427
Tilak, B. V. K. S. R. A.	459
Tonapi, G. T.	226
Tripathi, B. K.	131
Trivedi, B. S.	112
Trivedi, J. P.	219, 294, 415

	Page
Trivedi, K. N.	54
Tyagi, B. N.	407
Udai Bhan Singh	477
Udupa, H. V. K.	139
U. G. (*Rev.*)	80
Vaidyanadhan, R.	221, 386
Vaidya, P. B.	187
Varadaiah, V. V.	453
Varma (Miss), Asha	137
Vasantharajan, V. N.	26, 149
Vasanth Gurunath Rao	470
Vasudeva Murthy, A. R.	176
Venkataraman, B.	7
Venkataramani, K. S.	186, 319
Venkata Ram, C. S.	57, 186
Venkatesan, R.	64
Venkateswarlu, V.	259, 333, 414
Venkatraman, T. V.	73, 107, 390
Verma, A. N.	435
Verma, M. R.	10
Verma, S. C.	203
Verma, J. P.	450
Vijayalakshmi, U.	22, 107, 349
Vijayaraghavan, P. K.	298
Virmani, Y. P.	331
Vishin, M. L.	55
V. K. S. (*Rev.*)	358
V. N. K. (*Rev.*)	359
Vohra (Miss), S. K.	393
V. (*Rev.*)	76, 119, 197, 236, 355
Walvekar, A. P.	376
Yeddanapalli, L. M. (*Rev.*)	277
Zaka-ur-Rab, Md.	301

Subject Index

	Page
Abnormal Conjugation in *Spirogyra braziliensis*	154
ABO Blood Groups in the Raj Gonds	181
Absorption Cross-Sections for Nuclear Scattering of High Energy Nucleons	215
Acetic Fermentation of Molasses	383
Acoustic Radiation by Insects	164
Acrasiales, Occurrence of, in Indian Soils	24
Acyl Isothiocyanates : Friedelcraft Reaction	294
Addison-Wesley Series in Physics—Reading (Massachusetts, U.S.A.) (*Rev.*)	199
Advances in Agronomy, Vol. XII (*Rev.*)	279
— in Analytical Chemistry and Instrumentation (*Rev.*)	356
— in Catalysis and Related Subjects, Vol. XII (*Rev.*)	480
— in Chemical Physics, Vol. II (*Rev.*)	157
— — — —, Vol. III (*Rev.*)	396
— in Morphogenesis, Vol. I (*Rev.*)	442
— in Documentation and Library Science, Vol. III, Parts I and II (*Rev.*)	201, 442
— in Organic Chemistry (*Rev.*)	120
— in Space Science, Vol. II (*Rev.*)	437
Aeginetia indica, Linn. Hosts of the Root Parasite	319
— — —, Observations on a Root Parasite	191
Aerosol Layer in the Stratosphere	375
Aerosols—Science and Technology (*Rev.*)	439
Algæ, Cultivation of, in Heavy Water	8
All-Glass Sprayer for Paper Chromatography	143
Alpha Activities of Drinking Waters of Britain	135
Alternaria, A New Species from Bombay	470
—, Studies in the Enzyme Make-up of	450
Amino-Acid Deficiency of the Proteins of Lucerne Leaf	462
— — Make-up of *Santalum album*	417
Amitosis in the Endosperm of *Zephyranthes ajax*	72
Amperometric Determination of Cerium (IV) and Fe (III)	137
Analytical Elements of Mechanics, Vols. I and II (*Rev.*)	157, 483
Anchovy *Thrissocles vitirostris* from Indian Waters	104
Anion Uptake of a Cation Exchange Resin	258
Annual Reports of the Progress of Chemistry for 1959 (*Rev.*)	439
Antennæ of *Gerris fluviorum*, on the Growth of	226
Anthropology, Bienniel Review of (*Rev.*)	37

	Page
Apetalous Mutation in Tora Brown Sarson and its Inheritance	62
Aphids New to India	390
Appraisal of Newton's Mechanics and of Einstein's "Autobiography"	247
Aquatic Sciences, Current Bibliography for (*Rev.*)	36
Archegonial Complement of *Botrychium lanuginosum*	388
Astral Molecules : Bands of BaO ($^1\Sigma - ^1\Sigma$) System	376
Asymmetrical Factorial Designs Construction of	407
Atlantic Undercurrent	445
Atmospheric Pollution	41
— Temperature Fluctuations	244
Auto-Triploid of Rice and its Progeny	432
Award of Research Degrees 39, 83, 123, 162, 243, 320, 360, 402, 444,	485
Bacillus thuringiensis, Preliminary Trials with	29
Bacterial Inoculants, Use of, in Indian Agriculture	325
— Leafspot Disease of Jasmine	352
Basic Principles of Fission Reactors (*Rev.*)	483
Bean Fly, A Pest of French Beans	192
Beautiful Climbers of India (*Rev.*)	482
Behaviour of Chromium Glycine Complex at the Dropping Mercury Electrode	141
Benguela Current	289
Bibliography of Indology, Vol. I (*Rev.*)	82
Biennial Review of Anthropology 1960 (*Rev.*)	37
Binucleate Pollen Mother Cells in *Clitoria ternata*	306
Biological Activities of Steroids in Relation to Cancer (*Rev.*)	241
— and Chemical Control of Pests (*Rev.*)	358
— Effects of Radiation	205
Biovular Follicle and Binuclear Oocyte in Five-Banded Squirrel	304
Birbal Sahni Institute of Palæobotany	402
Blight of Fennel in Rajasthan	65
Blister Blight Disease of Tea Plants, Control by Nickel Chloride	57
Boiler Circulation Theory, Research into	133
Bone Mineral, Effect of Geological Ageing on Particle Size of	138
Books Received : 38, 82, 122, 161, 202, 242, 281, 318, 359, 401, 443,	484
Bradley Volume (*Rev.*)	280
Breakdown of the Papilionaceous Structure in *Clitoria ternatea* Flowers	435
British Association for the Advancement of Science	204
— Industrial Biological Research Association	40
Bromination of 2, 4-Substituted Quinoline Derivatives	15
Building Research, Conference on	243
Butterworth Publications in Chemistry (*Rev.*)	277
Callus Hair Length and Arrow Colour in Hybrids of *Saccharum*	188
Calobryum Nees—A Genus new to Indian Flora	22
Calomel Reference Electrode	459
Cambridge University Press Publications (*Rev.*)	355
Cancer Conference, All-India	243
Carbonaceous Meteorites	245
Carbon Dioxide Estimations in Stored Grain as Indication of Condition	361
Carbon-16, New Carbon Isotope	286
Carcinogenesis (*Rev.*)	481
Carnegie Institution : Year-Book No. 59 (*Rev.*)	255
Cassia tora : Local Lesion Host of Tobacco Mosaic Virus	353
Cellulose Research Symposium (*Rev.*)	358
Central Building Research Institute, Roorkee	124
Cerebrospinal Leptospirosis in Buffalo Calves	147
Ceylon Tea Soils, Determination of Ammonia and Nitrate	17
Chemistry and the Spectroscope	405
— of Heterocyclic Compounds, Vol. XV (*Rev.*)	438
— — Natural Products (*Rev.*)	35
— — Terpenes (*Rev.*)	357
Chlorophyll Deficiency in *Nicotiana tabacum*	467
Chromosome Complement of *Trigonomorpha cremulata*	150
— Numbers in Forage Grasses	393
— — — the Genus *Corchorus*	433
— — — — — *Curcuma*	194
— Number of Some Flowering Plants	73
— —s of Some Orchid Genera	75
Coconut Water, Biochemical Composition of	362
Codeine Phosphate as Pretreating Agent	30
Collagen, Structure of	127
— Symposium on	49

	Page
Collision of High Energy Particles with Light Nuclei	322
Colloid Chemistry, Introduction to (*Rev.*)	34
Colloquium on Documentation	320
Colocasia Blight, New Host Plant of,	354
Colour of the Sea	285
Comparative Biochemistry, Vol. I (*Rev.*)	357
Conductimetric Study on the Precipitation of Lead Arsenites	140
Conductive Organic Solids	34
Control of the Maize Borers *Chilo zonellus* and *Sesamia inferens*	266
— — Paddy Blast and Wheat Rusts	360
— — Safeda Muskmelon Fruit Rot	203
Corchorus olitorius and *C. capsularis*, Hybrids between	67
Corcyra cephalonica Staint, Effect of Antibiotics on	420
Correspondence of Sir Isaac Newton, Vols. I and II (*Rev.*)	197
Cosmic Ray Symposium, Proceedings of (*Rev.*)	76
Cotton in India, Vols. II, III and IV (*Rev.*)	81, 201, 441
Coumarin as Growth Stimulator of Maize Seedlings	448
—, PMR Spectrum of	331
Criteria for Grading Resistance of Sugarcane Varieties to Red Rot	425
Cryptococcus, on the Genus, in India	224
— *neoformans* from Patients in Poona	180
Cryptogams of Bhopal, A Note on	31
Crystal Structure of He^4 and He^3	320
— — of Lanthanum Magnesium Nitrate	53
— — of Rhodites and Ruthenites	52
— —s Supplement V (*Rev.*)	158
C.S.I.R.O. Research Review 1959-60 (*Rev.*)	400
Cucumis Virus 2C in Mosaic Infected Bottle-Gourd	273
Cultivation of Algæ in Heavy Water	8
Cup Leaf—A New Leaf Mutant in *Rai*	27
Current Bibliography for Aquatic Sciences (*Rev.*)	36
— Problems in Animal Behaviour (*Rev.*)	239
Cylindrocladium Parasitic on Tea Roots, A New Species of	186
Cytogenetics and Plant Breeding (*Rev.*)	280
— of an Interspecific Hybrid in Oryza	189
— of the Intergeneric Hybrid *Vaccaria grandiflora* × *Saponaria vaccaria*	327
Cytological Observations on the Indian Species of *Commelinaceæ*	310
Darwin's Place in History (*Rev.*)	120
Descriptive Palæoclimatology (*Rev.*)	440
Determination of Ammonia and Nitrate in Ceylon Tea Soils	17
Development and Future of Physics	213
— of Stomata in *Linum usitatissimum*	269
Diamagnetic Anisotropy of Benzene	377
— Susceptibilities of Isomeric Monosubstituted Nitrobenzenes	455
Di-Iodo Tetracarbonyl Iron II	259
Distribution of Urease within the Seeds of *Cajanus indicus*	297
Dissymmetry Measurements of High Polymer Solutions	453
Diurnal Variation of F_1 Region Drifts at Waltair	8
Documentation, Colloquium on	320
Dog-Tick *Rhipicephalus sanguineus*, on Prolonging the Longevity of, after Oviposition	265
Double-Cocoon Forming on *Philosamia ricini* and *Antheræa assama*	274
Double-Pass Jamin Interferometer	163
Double Phlox	162
— Star Astronomy (*Rev.*)	165
Dover Publications in Applied Mathematics (*Rev.*)	77
Downy Mildew of Maize, Perpetuation of, on *Kans*	114
Earth's Crust	89
— — under Indian Ocean	272
Earth Tides	410
Earthworm Eggs, Metachromasia of	422
Echitamine Iodide, Structure of	5
Ecological Problems in Tropics, Symposium on	41
Ecology of Acantharious and Circulation of Sr. in the Sea	205
Effect of Beta Radiation from P^{32} on *Bracon gelechiæ*	391
— of Electrical Oscillations on the Electric Field in the Glow Discharge	98
— of Fast Neutrons on Sexuality in Castor	305
— of Flower Suppression and Grafting on Nicotine Content in Tobacco	234
— of Gammexane on Flavoprotein Enzymes of Rat Liver	416
— of Geological Ageing on the Particle Size of the Bone Mineral	138
— of Gibberellic Acid on Berseem	203
— of Growth-Regulating Substances of Water Hyacinth Root Extract on Jute	428

	PAGE
Effect of IAA and Tiba on Vernalized Paddy	395
— of Infection of *Sphacelotheca schweinfurthiana*, on Spikelet Structure in *Erianthus munja*	22
— of Indole Acetic Acid on the Nitrogen and Carbohydrate Metabolism of Excised Wheat Leaves	24
— of Lucerne Supplement to Rice Diet on Circulating Hæmoglobin and Plasma Proteins of Rats	56
— of Moisture Content of Food Materials on Growth and Sex Ratio in *Corcyra cephalonica*	104
Ejaculatory Duct in *Empoasca devastans*	31
Elastic Scattering of 426 MeV Electrons by Li-6	51
Electricity from Flames	323
Electronic Transition Moment and Vibrational Temperature	216
Electrons in the Primary Cosmic Radiation	206
Electrophoresis, a Simple Method of Reducing Variations of Current	228
Element 103, Lawrencium	283
Embelin, Some Reactions of	333
Embryology of *Knoxia corymbosa* Willd.	190
Emplacement of Pegmatites in Kondapalle Area	20
Empoasca devastans, Modification of Ejaculatory Duct in	31
Endotrophic Sporulation among Species of *Streptomyces*	145
Enhanced Reduction Efficiency of Sodium Borohydride in the Presence of Titanium Tetrachloride	218
Enzyme Make-up of *Alternaria*	450
Epicoccum nigrum Link : A New Report from Indian Soils	69
Epimerisation at the C_4-Centre of a Flavan-3 : 4-Diol	142
Error Correcting Codes (*Rev.*)	480
Estimation of Galacturonic Acid by Paper Chromatography	337
— of Selenium with Thiourea	336
Etching of Antimony Single Crystals	293
Euproctis lunata Walker, Multiparasitism in Eggs of	69
Evolution as a Test for Ethics (*Rev.*)	214
Extracting Electricity from Flames	323
Extraction of Ascorbic Acid from Potatoes, Low Cost Reagent for	319
Extractive Metallurgy of Copper, Nickel and Cobalt (*Rev.*)	397
FAST NUTRON Physics (*Rev.*)	34
Fatty Oil from *Nigella damascena* Seeds	55
Feeding Mechanism of *X. cheopis*	465
Fern Rusts from India	308
Ferrielectrics	85
Fertilizers and Rice Production in India	124
Fertilizer Value of Dicalcium Phosphate	261
Fibre Content in Hemp and Sunn, Application of Gibberellins	177
Fibrous Thickening in the Anther Epidermis of *Wormia burbidgei*	426
Finger-Tip Patterns of the Car Nicobarese	103
Fish from a Depth of 7,580 Metres	41
Fishing Net Twines, Effect of Boiling	319
Flavylium Salts of Anthocyanidin Type, Preparation of	287
Flint × Dent Maize Hybrids Give Increased Yields	233
Floral Morphology of *Curcuma longa*	274
Fluid Inclusions in Barite from Pulivendla	263
Fluoride Complexes of Uranium (IV) and Thorium with Hydrazine and Hydroxylamine	293
Folin-Phenol Reagent for Measurement of Leaf Proteins	58
F_1 Region Drifts, Diurnal Variation of	9
Food Preservation, Use of Ionising Radiations for	290
Forest Development for India	256
Formation of Mn (II)—Formate Complex	14
— of Red Rot Acervuli on Sugarcanes	63
Fortschritte Der Hochfrequenztechnik, Vol. IV (*Rev.*)	159
Foundations of Modern Analysis (*Rev.*)	117
Free Radicals in Crystals	369
Fungi Causing Spoilage of Refrigerated Poultry Meat	64
—, Two New Genera, from Tertiary Coal Beds of Malaya	112
Furfural, Preservation of Alcoholic Solution of	198
GAGARIN, Yuri Alexeyevich, First Cosmonaut	136
Gall Midge Associated with Sugarcane Inflorescence	350
Gamma Radiation to Control Timber Pest	282
Gas Chromatography (*Rev.*)	438
General Physical Science (*Rev.*)	483
— Zoological Microtechniques (*Rev.*)	161
Generation of Optical Harmonics	403

	PAGE
Genetics and Plant Breeding, Indian Society of	123
— of Dwarf Growth in Common Wheat	271
Geological Society of India Journal	412
Geology of India and Burma (*Rev.*)	36
Germination of Grape Hybrid Seeds by Chilling	62
Gibberellin Induced Parthenocarpy in Guava	312
Glucose-6-Phosphate Dehydrogenase, Deficiency of	16
Glycogen Content of Marine Animals	353
Gossypium hirsutum, Viability and Fertility of Monosomics in	155
Granites of Hyderabad, Pink and Gray	264
Grasses of Burma, Ceylon, India and Pakistan (*Rev.*)	400
Gravimetric Determination of Cerium (IV)	457
Groundwater in the Submontane Tracts of Uttar Pradesh	329
Growth Regulators and Rooting of Cuttings in *Antirrhinum majus*	392
Guide-Book to Biochemistry (*Rev.*)	77
Gynœcium in the Ovary of *Rhinanthus major*	427
HAEMATOXYLIN Squash Technique for Study of Rat Liver Cells Nuclei	148
Hand-Book of Textile Testing and Quality Control (*Rev.*)	200
Haplosporella, a New Species of	312
Harb. I.M.I. Hand-Book (*Rev.*)	79
Hardboards from *Lantana*	340
Heavenly Clock (*Rev.*)	159
Helicostylum pyriforme on Sugarcane in India	107
Hermaphroditism in the Catfish *Mystus vittatus*	302
Heterodera major, a Simple Method of Hatching of Cysts of	360
Heteropolysaccharide from *Pasteurella multocida*	228
Heyiandia latebrosa DC.—A Promising Legume	67
High Energy Physics (*Rev.*)	87
— Intensity Magnet	361
— Resolution PMR Spectrum of Coumarin	331
— — Raman Spectroscopy of Gases	41
— Stretch Paper from Sisal Fibre	143
History of Science and Engineering in the Lands of the Orient (*Rev.*)	160
Homology Theory—An Introduction to Algebraic Topology (*Rev.*)	198
Homopterocarpin, Synthesis of a Recemate of	218
Humanity of Man	324
Hydrogen Cloud of Terrestrial Origin	486
— Maser	41
Hydrospheric Origin of Lunar Surface Features	83
Hyperon Stars	321
I.C.A.R. Grant to *Current Science*	123
Ice, Vitreous, Structure of	164
Illustrated Genera of Wood Decay Fungi (*Rev.*)	481
Improved Basal Medium for the Microbiological Assay of Riboflavin using *Lactobacillus casei*	418
Impulse Voltage Testing (*Rev.*)	356
Index of Chemistry Films (*Rev.*)	37
Indian Academy of Sciences: XXVI—Annual Meeting	3
— Botanical Society	83
— — — Memoris	444
— Essential Oils (*Rev.*)	316
— Journal of Microbiology	205
— Pharmaceutical Congress Association	162
— — —	282
— Science Congress	4
— Standards Institution, XIII Annual Report	281
India's Population According to 1961 Census	174
Indigenous Drugs, Symposium on	40
Inducement of Anther Dehiscence in a Sugarcane Variety	113
Industrial Electric Furnaces and Applications (*Rev.*)	118
— Spectroscope	409
Influence of Host Plants on the Amino-Acid Make-up of *Santalum album* Linn.	417
Information Retrieval and Machine Translation, Parts I and II (*Rev.*)	201, 442
Infra-Red Methods, Principles and Applications (*Rev.*)	198
— Molecular Emission Spectroscopy by Michelson's Interferometer	362
— Physics—International Research Journal	284
— Spectroscopy, Recent Advances in	1
— Spectra of Water	43
Inheritance of Hairy Character on Black Gram Pods	434
— of the Retule Leaf Apex in Cross between *Crotalaria striata* and *C. mucronata*	476

	PAGE
Insecticidal Properties of *Zanthoxylum alatum*	223
Institute of Physics and Physical Sciences	320
— — — — — Society	213
— — — — — — — Awards	40
— — — — — — — Symposia	402
— of Chemists	204
Insulin (*Rev.*)	317
Intensity Sensitivity of Human Eye ..	206
Interplanetary Magnetic Field and the Auroral Zones	163
International Conference on Neurosecretion	363
— — — Physics of Semiconductors ..	320
— — — Protozoology	364
— Congress of Pure and Applied Chemistry	83
— — of Radiation Research	123
— Control of Investigations of Rare Meteorites	212
— Rubber Conference	402
— Society for Tropical Ecology—1962 Symposium	162
Introduction to Astrodynamics (*Rev.*)	315
— to Biochemistry (*Rev.*)	278
— to Electronic Theory of Organic Compounds (*Rev.*)	199
— to Homological Algebra (*Rev.*) ..	117
— to Laplace Transformation (*Rev.*)	398
— to Physical Chemistry (*Rev.*) ..	281
— to Statistical Thermodynamics (*Rev.*)	275
— to Quantum Field Theory (*Rev.*)	76
Iodometric Amperometric Determination of Copper (II)	12
Ionising Radiation for Food Preservation	290
Irreversible Polarographic Waves, Application of, to Reduction of Brilliant Green	175
ISI Hand-Book of Quantities (*Rev.*) ..	38
JETS and Rockets (*Rev.*)	77
Journal of Catalysis	485
— of Experimental and Molecular Pathology	485
— of Theoretical Biology	204
KYANITE-Quartzite, Occurrence of ..	19
Kyushu Earthquake—Gravity Record at Hyderabad	183
LAC Insect, *Kusmi* Strain of	152
Lady Tata Memorial Trust Scholarship	40, 243
Land and Freshwater Mollusca in the Collection of the Madras Government Museum (*Rev.*)	80
Lawrencium, Element 103	283
Leaf Distorting Virus Disease of *Jatropha curcas*	345
— Protein in Nutrition	298
Leafspot Diseases	343
Lectures on Linear Algebra (*Rev.*) ..	479
Lehrbuchen Der Theoretischen Physik (*Rev.*)	158
Liesegang Rings, Influence of Adsorbent on the Formation of	336
Light Amplifier Tube to Photograph Cosmic Ray Tracks	86
Living Body (*Rev.*)	119
Locust	42
Long-Distance Signals *via* Moon ..	124
Low Pressure Mercury Lamp ..	163
— Temperature Transformer ..	487
Lunar Crater Alphonsus, Origin of C_2 Molecules Observed	404
MAGNETISM and Molecular Structure: Estimate of Metal-Nitrogen Bond ..	456
Magnetohydrodynamics; Electricity from Flames	323
Malacological Congress, First European	243
Malvaceous Species, Meiotic Studies in	26
Mandelic Acid, Reaction of, with Sodium Molybdate and Tungstate ..	380
Mango Bunchy-Top and the Eriophyid Mite	114
Manned Space Flight, United States' Success in	167
Marasmia trapezalis, Natural Enemies of	73
Marine Fossiliferous Lower Eocenes ..	360
— Wood-Borer, *Xylophaga* from Bay of Bengal	464
Mechanics (*Rev.*)	314
Mechanisms in Radiobiology, Vol. II (*Rev.*)	238
Medicinal Chemistry (*Rev.*)	122
Meiotic Studies in Some Malvaceous Species	26
Meloidogyne javanica (Trueb), Host Range of Sugarcane Root-Knot Nematode	149
Memoirs of the Indian Botanical Society	444
Mercuration of Compounds Containing Reactive Methylene Group ..	333
Mercurochrome as a Spray Reagent ..	144
Meson Physics (*Rev.*)	355
Mesta as a Border Crop on Sugarcane Plantation	206
Metabolic Pathways, Vol. I (*Rev.*) ..	277
Metabolism of Oral Tissues (*Rev.*) ..	279
Metacercaria of *Aphanurus* from a Copepod *Acrocalanus gracilis* ..	225

	PAGE
Metacercaria of *Eumegacetes* in Dragon-Fly Naiads	303
Metachromasia of Earthworm Eggs	422
Meteorites, Age of	84
—, Carbonaceous	245
—, International Control of Investigations of	212
Methods of Biochemical Analysis, Vol. VIII (*Rev.*)	238
Microbial Disease of *Ophiusa coronata*	390
— Genetics, Symposium (*Rev.*)	242
— Reaction to Environment (*Rev.*)	441
Microbiological Assay of Riboflavin using *Lactobacillus casei*	418
Micro-Chamber for Incubation of Plant Section and its Growth Rate Measuring	264
— Elements in Human Body	42
Microfungi from Usar-Soils of India New Records of	345
Micro Hydel Sets for Power Generation	282
Micrometeorite Layer at High Altitudes	487
Mn (II)—Formate Complex, Formation of	14
Mode of Infection in Sawan Smut	189
Mohole, U.S. Project	246
Moisture Content of Parboiled Rice Determination by Immersion Method	261
Molasses, Acetic Fermentation of	383
Molecular Electronics	207
Molybdate-Tungstate Antagonism in *Neurospora crassa*	219
Morphogenetic Responses of the Thallus of *Marchantia* to Growth Substances	131
Morphology, Cytology and Breeding Behaviour of Hybrids between *Corchorus olitorius* and *C. capsularis*	67
— of Onge Foot	300
— of the Pollen Grains of *Cucurbita*	469
Moss Flora, Polish Læss, Compositions and Adaptation Modifications of	313
Multiparasitism in the Eggs of *Euproctis lunata*	69
Multiple Allelism for Petal Colour in *Linium grandiflorum*	109
Multivariable Control Systems in the Light of Symmetrical Components	306
NATIONAL Physical Laboratory, Annual Report for 1960	292
Natural Control of Potato Tuber Moth	319
Nepal (*Rev.*)	80
Neurosecretion—Third International Conference	363
New Moons	403
New Standard for the Metre	233
Nicotinamide Deamidase in Germinating Pulses	461
Nimrod Injector, Successful Operation of	406
Nitrogen and Carbohydrate Metabolism of Excised Wheat Leaves, Effect of Indole Acetic Acid on	24
— Content of Wood-Boring *Martesia*	185
Non-Linear Systems, Some New Concepts in	134
Notulæ Embryologicæ: Functions of Endosperm in *Avicennia officinalis*	424
Nuclear Magnetism, Principles of (*Rev.*)	446
Nucleolar Number and Polyploidy Level	476
— Scattering of High Energy Nucleons, Absorption Cross-Sections for	215
OCCURRENCE of Acrasiales in Indian Soils	24
— of Amino-Acids and Allin in the Indian *Alliums*	338
— of C_8 Units in Xanthones	90
— of Intracortical Roots in *Bambusa*	308
— of Kyanite-Quartzite from Varuna Schist Belt, Mysore	19
— of Root-Knot Nematodes on Betel-vine	351
— of Twin Embryo-Sacs in *Capparis aphylla*	187
Ocean Basins and Continents, Origin of	321
Odour and Molecular Vibration	322
Organic Electronic Spectral Data, Vols. I and II (*Rev.*)	275
Origin of Lunar Domes	446
— of Ocean Basins and Continents	321
— of Vempalle Shales and Limestones in Cuddapah Basin	386
Ostracoda, Discovery of, from the Upper Cretaceous Bagh Beds	341
—, Occurrence of, in Rocks of Paleocene Age	222
Ovine Abortion due to *Toxoplasma gondii*	299
Oxidation of Thiocyanate with Chloramine-T	176
Oxygen Intake by Rice Plant Roots	445
PACHYTENE Analysis in *Japonica indica* Rice Hybrids	70
Pachytene Analysis in *Melilotus segetalis*	232
Paint Technology Manuals (*Rev.*)	398
Paper Chromatographic Methods of Separation of Cu, Ni and Co	10

	Page
Parasitic Nematodes of Sugarcane in Bihar	193
Pasteurella multocida, a Rare Serotype of, Causing Pneumonia in Sheep	267
Pebrine Germ of *Philosamia ricini* Hutt., Infective Capacity on *Bombyx mori*	28
Pegmatites, Emplacement of, in Kondapalle Area	20
Pelagic Fish Spawn, on the Occurrence of	61
Peptide, a New, from Brain	296
Perfumes Cosmetics and Soaps (*Rev.*)	160
Permo-Carboniferous, Discovery of Marine, in the Western Rajasthan	262
Perspectives in Virology, Vol. II (*Rev.*)	481
Perspex Electrets	11
Pertussis Vaccine, a Modified Medium for Production of	263
Petrified Monocotyledonous Leaves from the Tertiary of Madhya Pradesh	342
Petrology for Students (*Rev.*)	201
Peyronellæa, a New Species of	343
Photolytic Preparation of Uranium (IV) Sulphate Complexes	380
Photosynthesis	45
Physical Chemistry (*Rev.*)	483
— Principles of Astronautics (*Rev.*)	398
Physics of the Atom (*Rev.*)	236
Piedmontite from Goldongri Manganese Mine	223
Piezometer for the 100-Kilobar Region	283
Pistacite from the Granites of Putalapattu	295
Plant Nematodes, their Bionomics and Control (*Rev.*)	399
Plasma Diode	245
— Pinch, Miniature Sun Created by	251
— Protein, Vols. I and II (*Rev.*)	35, 120
Polyarthritis in Sheep in India	59
Polyembryony in Mulberry	203
Polyhaploid Plant of *Sorghum halepense*	347
Polyvinyl Chloride Coating for Glass Bottles	205
Possible Parent Substances for the C_2 Molecules in the Alphonsus Crater	404
Potato Root-Eelworm *Heterodera rostochiensis*	187
Potential Constants and Termodynamic Properties of IF_5 and IF_7	413
— Constants and Thermodynamic Properties of $SiBr_3I$	377
— — of Cyclopropane and Cyclopropane d_6	332
Powdery Mildew on *Gmelina arborea*	155
Prawn Processing, Use of Chilled Water in	388
Premna resinosa Schau (Verbenaceæ), An Addition to Indian Flora	21
Preparative Methods of Polymer Chemistry (*Rev.*)	276
Presoaking of Cereals in Antibiotics	477
Prevention of Flowering in Sugarcane	211
Principles of Animal Virology (*Rev.*)	359
— of Electrolysis (*Rev.*)	37
— of Modern Physics (*Rev.*)	76
— of Nuclear Magnetism (*Rev.*)	447
Proceedings of the Centenary and Bicentenary Congress of Biology, Singapore, 1958 (*Rev.*)	202
— of the Cosmic Ray Symposium, 1960 (*Rev.*)	76
— of the International Congress of Mathematicians, 1958 (*Rev.*)	157
— of the Natural Rubber Research Conference (*Rev.*)	484
Progress of Chemistry for 1959, Annual Report (*Rev.*)	439
— in Endocrinology (*Rev.*)	276
— in Inorganic Chemistry (*Rev.*)	78
Proton Magnetic Resonance in Sesamin and Asarinins	252
Protozoology—First International Conference	364
Pteridophytes of Nagpur	430
Qualitative Organic Analysis (*Rev.*)	241
Radar Meteorology (*Rev.*)	119
Radioactive Wastes Fixed in Glass	486
Radioactivity for Pharmaceutical and Allied Research Laboratories (*Rev.*)	79
Radiofrequency Spectroscopy, Varenna Summer School	7
Radioisotopes in Biology	86
Radio Waves from Saturn	41
Rafi Ahmed Kidwai Memorial Prize	123
Rain Formation, Nuclei for	449
Raman Chair in Physics in the Madras University	40
— Spectrum of Deuterated Methane (CD_4)	213
— — of Gaseous CF_4	125
Raptakos Medical Research Fellowships	83, 282, 485
Rare-Earths, Separation of	221
Reaction of Shadow in *Dasychone Cingulata*	186
—s of Epichlorohydrin with phenols	99
Reactor Handbook, Vol. I (*Rev.*)	237

	PAGE
Real Objective Plane (*Rev.*) ..	314
Rearing of more than One Generation of Univoltine Silkworms	435
Recent Advances in Infra-Red Spectroscopy	1
Red-Shift, A large	171
Report of the Rothamsted Experimental Station for 1959 (*Rev.*)	121
Representation of Primes by Quadratic Forms (*Rev.*)	119
Reproduction Paper for Printing Chromatogram	39
Resistance of Paddy Varieties to Blast	272
Response of Hybrid Maize to Zinc Fertilisation	473
Reversions in Drug Resistance of *Vibrio cholerae*	417
Rhizosphere Microflora of Citrus Plants, Influence of Streptomycin Spray ..	25
Rhodites, Crystal Structure Data of	52
Rocket to Venus	44
Rocks at Pandava Falls in Panna State	56
Role of Plants in the Movement of Phosphorus by Radioactive Isotopic Studies	180
Root-Knot Nematode, Screening Sugarcane Varieties for Resistance to ..	349
— —s on Betelvine	351
Root Parasite *Aeginetia indica* ..	244
Rotational Multiplets in the Oscillation Spectrum of the Earth	322
Rotating-Wall Laboratory for Building Research	444
Rotifers from Shallow Ponds in Delhi ..	268
Royal Institute of Chemistry: Monographs for Teachers (*Rev.*) ..	358
Ruminate Endosperm in the Canellaceæ	344
Russia Sends First Man into Space ..	136
SALT Pseudomorph Shales from the Upper Vindhyans	163
Sanasar Cirque	147
Sand Culture Technique for Study of Trace Element Deficiencies ..	427
Sands of Cape Comorin, Heavy Accessory Study of	384
Santalum album Linn. Influence of Host Plants on the Amino-Acid Make-up of	417
Scientific Documentation, Regional Seminar	83
Screening of Rice Varieties for Resistance to Foot-Rot Disease ..	145
— Sugarcane Varieties for Resistance to Root-Knot Nematode	349
Second Course in Statistics (*Rev.*) ..	399
Segregation for Lanky and Normal Seedlings in Sorghum	188
Seismic Exploration in the Cauvery Basin of Madras State	168
Seminar on Electrochemistry ..	282
Separation of Rare-Earths	221
— of Uranium from Sodium-Diuranate by Photolysis	54
Sewage and Activated Sludge as Source for Isolation of *Azotobacter agilis*	382
Sex Differentiation and Development (*Rev.*)	317
Shepard, Alan, U.S. Astronaut ..	167
Silkworms, Rearing of Univoltine ..	435
Simultaneous Occurrence of *Tilletia fœtida* and *Anguillutina tritici* in Wheat	307
Single Value Measure for Soil Texture	106
Sixth Degree Cubic Field, Effect of, on Rare-Earth Ions in Crystals ..	217
Skeleto-Muscular System of the Sucking Pump of *Papilio demoluis* ..	301
Soil Fungi, Two New Records ..	231
— Texture, Single Value Measure for	106
Solar Corona, Long Wavelength Spectrum of	130
— Energy	94
— High Voltage Electricity Generator	39
Solution of Equations and Systems of Equations (*Rev.*)	437
Sound Waves Trapped in the Solar Atmosphere	486
Space Radio-Telescope	244
— Trajectories (*Rev.*)	479
Spark Chamber	404
Spawning Grounds of Indian Shad, *Hilsa ilisha* in Freshwater Regions	373
Spectrum of Sun from High Flying Aircraft	284
Sphacelotheca schweinfurthiana, Effect of Infection of, on Spikelet Structure in *Erianthus munja*	22
Sphæropsis knots on Lime in Rajasthan	110
Sphærotheca on *Euphorbiaceæ* from Hyderabad	433
Sporophyte of *Jungermannia viridis* ..	430
Stacking Faults in Gold-Cadmium Alloy	379
Starch Content of *Saccharum spontaneum* Varients	113
Stemphylium and *Pseudostemphylium*	423
Steroids as Ice Nucleators ..	446
Stochastic Processes, Introduction to (*Rev.*)	33
Stomata in Coleoptile of *Oryza sativa* L.	30

	Page
Streblus asper Lour., Chemical and Pharmacological Examination of	420
Streptomycin and Kanamycin, Cross-Resistance of	462
Stromatolites in Lower Cuddapah Limestones	221
Structural and Topographic Trends in Kondapalle Area	115
— Materials in Chemical Technology	445
Structure and Function of Muscle, Vol. II (*Rev.*)	316
— and Ontogeny of Epidermal Appendages of *Ocimum basilicum*	471
— of Collagen	127
— of Echitamine Iodide	5
— of Vitreous Ice	164
Studies in Indian Medicinal Plants Used in Ayurveda (*Rev.*)	399
— in *Physalia physalis* (*Rev.*)	240
— on the Rhizosphere Microflora of Citrus Plants as Influenced by Streptomycin Spray	25
Sugarcane Mite on Jowar	107
—, Prevention of Flowering in	211
Sulphonamidoiodophthaleins	460
Sulphur Fumes from Chemical Plants, Removal of	206
Summer School on Radiofrequency Spectroscopy, Varenna	7
Superconductors for Strong Magnetic Fields	244
Superposable Pictures of Chromosome Structure of *Allium cepa* in Feulgen and Hæmatoxylin Squashes	172
Swim-bladder Structure of Deep-Sea Fishes (*Rev.*)	440
Symposia on Vacuum Physics and Nuclear Physics	402
Symposium on Carbohydrate, Cellulose and Cellulose Industry	282
— on Collagen	49
— on Ecological Problems in Tropics	41
— on Explosives	96
— on Ferrow-Alloy Industry in India	402
— on History of Sciences in India	162
— on Indigenous Drugs	40
— on Low Temperature Carbonisation of Non-Caking Coals	204
— on Plant Tissue and Organ Culture	444
— on Production and Utilisation of Medical and Aromatic Plants in India	243
— on Scombroid Fishes	485
— on Thyro-Gonard-Adrenal-Pituitary Relationships (*Rev.*)	37
Syntheses of O-Trimethyl Alloteracacidin and O-Trimethyl Alloisoteracacidin	101
Synthesis of Racemate of Homopterocarpin	218
— of 4 : 5 Dihydroxy-Coumarin	54
— of N-Methyl-2-Azabicyclo (3, 3, 0) Octane	414
— of Thioureido-Benzophenones	219
— of Thioureido-Triphenylmethanes	415
— of *p*-Benzohydroquinone-1-C^{13}	370
Synthetic Ion-Exchangers (*Rev.*)	397
Tables of the Reimann Zeta Function (*Rev.*)	314
Tamarind Leaves, Organic Acid Metabolism in	381
Taxonomy of Earthworm in India	361
Tenth Symposium of the Society for General Microbiology (*Rev.*)	242
Termites Infesting Sugarcane Crop	229
Tetramerous Flower of *Abutilon indicum*	403
Text-Books in Mathematics (*Rev.*)	197
Theoretical and Applied Mechanics Sixth Congress on,	123
— — — —, Seventh Congress	360
— Physics in the 20th Century : Memorial Volume to W. Pauli (*Rev.*)	315
Theory of Differential Equations (*Rev.*)	236
— of Optics (*Rev.*)	236
— of Probability (*Rev.*)	355
— of Universe, Explosive Evolution	125
Thoracic Glands in *Mylabris pastulata*	111
Three-Electrode Trigger in the Spectral Study of Exploding Wires	257
Throwing Power of Lead Nitrate Bath for Anodic Deposition of Lead Dioxide	139
Thyro-Gonad-Adrenal-Pituitary Relationships, Proceedings of the Symposium on (*Rev.*)	37
Thyroid Gland (*Rev.*)	241
Titov, Major Gherman, Russia's Second Cosmonaut	365
Titration Coulometer	13
Tobacco, Nicotine Content in, Effect of Grafting on	234
Tolyposporium ehrenbergii (Kuhn)	486
Tooth Enamel Protein, Nature of	85
Top-Shoot Borer of Maize, New Host Plants of	109
Total Soluble Salts in Black Clayey Soils	108
Toxicology—Mechanisms and Analytical Methods, Vol. I (*Rev.*)	200
Transition Probabilities in Astral Radicals : LaO (B → X) System	137

	PAGE
Translocation of Radioactive Schradan in Plants	105
Treatise on Analytical Chemistry : Part I (Vol. II) (*Rev.*)	396
— on the Analytical Dynamics of Particles and Rigid Bodies (*Rev.*)	236
Tribes and Castes of Nilgiri Hills, Dermatoglyphic Study of	463
Tropical Ecology, 1962 Symposium	162
Turkmenia's Academy of Sciences, Tenth Anniversary of	320
2 : 4 - Dinitrophenylhydrazones of some Flavanones	414
2-Steryl Derivatives of 4 (3)-Quinazolones as Potential Antimalarials and Amœbicides	179
ULTRASONIC Velocity in Inorganic Solutions and Melts	454
Universe, New Theory of	125
Unusual Mode of Egg-Laying in *Trogoderma granarium*	230
Up-take and Reduction of Bromate by Wheat Roots	102
Urea-Form, A New Fertiliser	182
VANADIUM-Bearing Titaniferous Magnetites	183
Varenna Summer School on Radiofrequency Spectroscopy	7
Variation among Rice Varieties in Regard to Germination under Submersion and Heat Stability of Chlorophyll	235
Vegetative Propagation of Cultivated Rice	474
Venus, Radio Location Studies of	246
Viability and Fertility of Monosomics in *Gossypium hirsutum*	155
— of Stored Seed Wheat	466
Vilangin—A New Constituent of *Embelia ribes*	259
Virus Disease of *Odontonema nitidum*	431
"Vostok"—Russia's First Manned Satellite	136
— II—Russia's Second Manned Space-Ship	365
WATER and Agriculture (*Rev.*)	81
Whistlers	125
White Dwarf Cluster, Discovery of	321
Wilting of Big Rain Trees in Calcutta	307
Wind as a Source of Energy in India	95
World Population Trends	445
XANTHOHUMOL, Constitution of	333
X-Ray Microscopy (*Rev.*)	315
ZEEMAN Effect, Mechanical Counterpart in Free Oscillations of Earth	322
Zeiss Instruments at the 1961 Leipzig Fair	96
Zone Plate Spectrometer for the Far Infra-red	125

913–61. Printed at the Bangalore Press, Bangalore City, by T. K. Balakrishnan, Superintendent.